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OF THE

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1902.

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(*Elected April 29th,* 1902.)

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PROCEEDINGS

OF THE

GENERAL MEETINGS FOR SCIENTIFIC BUSINESS

OF THE

ZOOLOGICAL SOCIETY OF LONDON.

1902, Vol. I. (January to April).

January 14, 1902.

Prof. G. B. Howes, LL.D., F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of December 1901:—

The registered additions to the Society's Menagerie during the month of December 1901 were 51 in number. Of these 11 were acquired by presentation and 4 by purchase, 6 were born in the Gardens, and 30 were received on deposit. The total number of departures during the same period, by death and removals, was 146.

Dr. A. S. Woodward, F.R.S., exhibited a newly-discovered upper molar tooth of a Fossil Horse, *Onohippidium*, from the cavern near Consuelo, in Last Hope Inlet, Patagonia[1]. This specimen was fixed in the bone and carried traces of the soft parts.

Mr. Oldfield Thomas, F.R.S., exhibited the skin and skull of a female Yellow-backed Duiker (*Cephalophus sylvicultrix*) which

[1] *Cf.* P. Z. S. 1900, p. 76.

had been obtained by Mr. B. B. Johnstone (Native Commissioner) in the Awemba district of North-eastern Rhodesia, and had been sent home and presented to the British Museum by Mr. Robert Codrington, Administrator of that country.

This specimen proved a very considerable extension of the range of the species, hitherto known only from West Africa, where it had a wide distribution, from Sierra Leone to Angola. No differences of importance, however, were perceptible between the Rhodesian specimen and examples from West Africa.

Since Mr. Codrington's specimen had arrived, a frontlet and piece of skin of the same species had also been received from Mr. O. Baragwanath of Bulawayo, and this, it was believed, had been obtained in the same district.

In N.E. Rhodesia this Antelope was said by Mr. B. B. Johnstone (who had obtained the specimen for Mr. Codrington) to be met with in stony localities at fairly high altitudes. It was supposed to occur throughout the Luemba Highlands and along the Mohinga Mountains east of Lake Bangweolo, but was not common. Its cry was like that of a Duiker. Its native name was "Chibusimawe" (=Big Mountain Goat).

Mr. W. B. Tegetmeier, F.Z.S., exhibited the skin of an animal which it had been suggested was a hybrid between a Hare and a Rabbit, but which had proved to be merely a Mountain Hare (*Lepus variabilis*).

Mr. Tegetmeier also exhibited a skull of a Rabbit showing overgrown incisors in both jaws.

The following papers were read:—

1. On Variation in the Number and Arrangement of the Male Genital Apertures in the Norway Lobster (*Nephrops norvegicus*). By F. H. A. Marshall, B.A., Christ's College, Cambridge[1].

[Received November 21, 1901.]

(Text-figures 1–3.)

The total number of specimens of the Norway Lobster examined for the purposes of this investigation was 1123, of which 1080 were males. The latter presented no less than ten different arrangements of the genital apertures, in addition to the normal arrangement of an opening on the basal joint of each of the fifth walking-legs. Before giving the numerical details of the degrees

[1] Communicated by W. Bateson, F.Z.S.

of frequency of these arrangements, it will be convenient to describe each of them separately. They are as follows :—

A. The normal arrangement.

B. The normal apertures and two additional ones at the bases of the fourth legs, making a total of four apertures.

C. The normal apertures and an additional one at the base of the left fourth leg, making a total of three apertures.

D. The normal apertures and an additional one at the base of the right fourth leg, making a total of three apertures.

E. The normal apertures and four additional ones on the third and fourth legs, making a total of six apertures.

F. The normal apertures and three additional ones on the fourth legs and the left third leg, making a total of five apertures.

G. The normal apertures and three additional ones on the fourth legs and the right third leg, making a total of five apertures.

H. The normal apertures and two additional ones on the left third and left fourth legs, making a total of four apertures.

K. The normal apertures and an additional one on the left third leg (there being a gap in the series), the total number of apertures being three.

L. The normal apertures and two additional ones on the right third and left fourth legs, the total number of apertures being four.

M. The normal apertures and five additional ones on the fourth and third legs and also on the left second leg, the total number of apertures being seven.

These arrangements may be represented graphically as follows :—

B.		C.			D.		E.	
r.	*l.*	*r.*	*l.*		*r.*	*l.*	*r.*	*l.*
				Third legs.			•	•
•	•		•	Fourth legs.	•		•	•
•	•	•	•	Fifth legs.	•	•	•	•

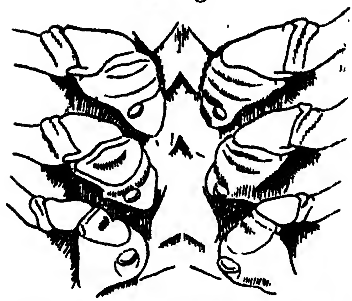
F.		G.			H.		K.	
r.	*l.*	*r.*	*l.*		*r.*	*l.*	*r.*	*l.*
	•	•		Third legs.		•		•
•	•	•	•	Fourth legs.		•		
•	•	•	•	Fifth legs.	•	•	•	•

L.			M.	
r.	*l.*		*r.*	*l.*
		Second legs.		•
•		Third legs.	•	•
	•	Fourth legs.	•	•
•	•	Fifth legs.	•	•

[The letters *r.* and *l.* denote the right and left sides.]

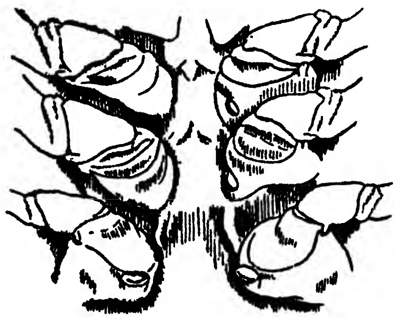
1*

Text-fig. 1.



Genital apertures of *Nephrops norvegicus.*
Male of *Nephrops norvegicus* having abnormal genital apertures on each of the third and fourth walking-legs.

Text-fig. 2.



Genital apertures of *Nephrops norvegicus.*
Male of *Nephrops norvegicus* having abnormal genital apertures on the right third and right fourth walking-legs.

In no specimen was either of the normal apertures wanting.

The animals were examined in batches—the first batch, which was much the largest, consisting of the stock of Norway lobsters in the zoological laboratory of the University of Edinburgh, obtained for the use of students during the summer session. The rest were procured at various intervals of time during the summer and autumn. The numerical details of these batches are now given:—

(1) Females	56		
Normal males	485		548
Abnormal males with arrangement B	23	63	
Ditto with arrangement C	21		
" " D	17		
" " E	1		
" " H	1		
Total	604		

(2) Females	2		
Normal males	60		
Abnormal males with arrangement B...	3		
Ditto with arrangement C	1	7	67
” ” D	2		
” ” K	1		
Total ...	69		

(3) Females	3		
Normal males	80		
Abnormal males with arrangement B...	5		
Ditto with arrangement C	3		
” ” D	3	14	94
” ” F	2		
” M	1		
Total ...	97		

(4) Females	4		
Normal males	95		
Abnormal males with arrangement B...	1		
Ditto with arrangement C	8		
” ” D	2	13	108
” ” F	1		
” ” G	1		
Total ...	112		

(5) Females	1		
Normal males	41		
Abnormal males with arrangement B...	2		
Ditto with arrangement C	1		
” ” D	2	8	49
” ” E	1		
” ” G	1		
” , L	1		
Total ...	50		

(6) Females	1		
Normal males	22		
Abnormal males with arrangement B...	1	2	24
Ditto with arrangement D	1		
Total ...	25		

(7)	Females	1		
	Normal males	73		
	Abnormal males with arrangement B...	4		85
	Ditto with arrangement C	5	12	
	" " D	3		
	Total ...	86		

(8)	Normal males	22		
	Abnormal males with arrangement B...	1		25
	Ditto with arrangement C	1	3	
	" " D	1		
	Total ...	25		

Adding all these together we arrive at the following result:—

Females	68		
Normal males	878		
Abnormal males with arrangement B...	40		
Ditto with arrangement C	40		
" " D	31		
" " E	2		
" " F	3		1000
" " G	2	122	
" " H	1		
" " K	1		
" " L	1		
" M	1		
Grand Total....	1068		

The total number of male Norway lobsters examined being 1000 [1], the percentage of abnormality occurring among them is shown to be 12·2. The numerical variation in the apertures, but not the variation in their arrangement, I have indicated by a percentage curve (text-fig. 3, p. 7). It is of interest to note that the homœosis occurs with little regard to bilateral symmetry.

The relative scarcity of females is worthy of comment. It may be that the majority of them had migrated to a greater distance from land. The 68 specimens that were examined possessed only the normal apertures on the third pair of walking-legs. Dr. Malcolm Laurie, however, tells me of a female specimen in his possession which has two pairs, the additional ones being on the fourth pair of legs.

The 1068 Norway lobsters which enter into my calculations

[1] Since the above was written I have received 24 male Norway lobsters from the Forth area, 21 being normal, one showing arrangement C and another arrangement D, while a third presented an arrangement not hitherto observed, having apertures upon the left third and right fourth walking-legs in addition to the normal ones, the total number of apertures being four.

were all obtained from the area of the Firth of Forth. In addition to these I procured 80 specimens which were caught off the Isle of Man. Of these two were females, one was an abnormal male having two pairs of genital apertures, and the rest were

Text-fig 3.

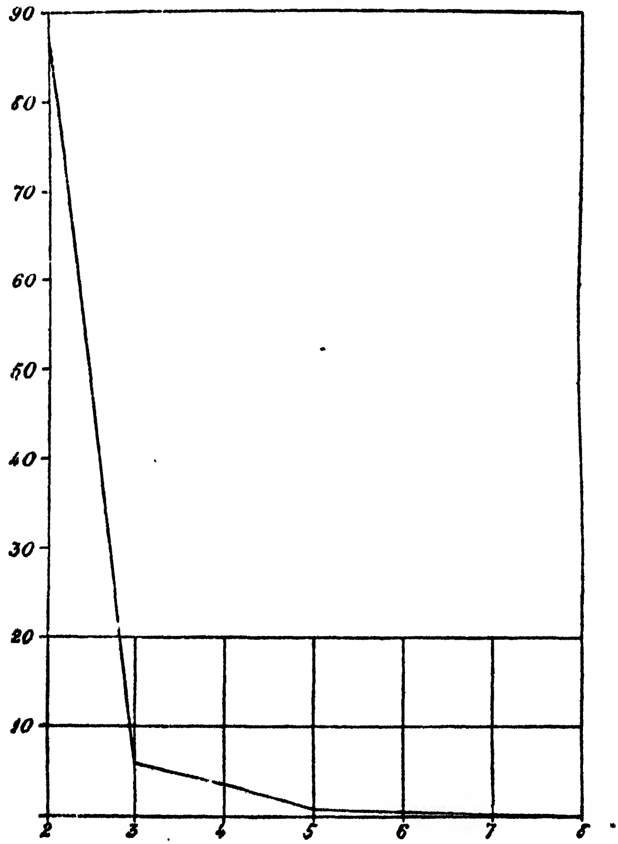


Diagram illustrating variation in genital apertures in *Nephrops norvegicus.*

Percentage-curve illustrating variation in the number of genital apertures in 1000 male specimens of *Nephrops norvegicus.* The lower figures give the number of apertures and the side figures the percentage of individuals.

normal males. The number is, of course, not large enough for any definite conclusions to be based upon it; but in view of the fact that I never obtained even smaller batches from the Forth area without finding a much higher percentage of abnormality, the presence of only a single abnormal specimen among the Isle

of Man lobsters may point to the percentage being related to the locality[1].

The positions of the additional openings upon their respective legs are approximately the same as those of the normal ones on the fifth legs. In the case of those specimens with three pairs of openings, the most anterior of which are situated on the third legs in the position of oviducal openings, it is clear, if only from the modification of the anterior abdominal appendages, that the specimens are males. The abnormal apertures are sometimes smaller than the normal ones, though they may be even larger. In the case of the single specimen showing seven spermatic apertures, the six posterior openings are of about equal size, while the opening on the second thoracic leg on the left side is very much smaller but still quite obvious.

The state of preservation of the majority of the specimens rendered it impossible to determine the structure of the internal genital organs. In the fresh specimens it could, however, in some cases be made out that the apertures opened internally into blind sacs. In a few there appeared to be duct-like extensions of these sacs internally. In a fair proportion the vasa deferentia gave off branches which extended for a short distance towards the abnormal openings. In at least one instance these anterior forks of the vasa deferentia reached the bases of the legs on which the abnormal apertures were situated. Whether there is ever a free functional passage from the position of the forking to the abnormal aperture it is difficult to say with certainty.

That Norway lobsters with additional genital apertures have been common in Scottish waters for a considerable number of years, appears from information supplied me by Professor Ewart, Dr. Beard, Dr. Masterman, and others. Before I began my investigation on the degree of frequency of such abnormal lobsters, Dr. Masterman expressed the opinion that quite 10 per cent. of the specimens he had observed since he had been in Scotland had additional genital openings; and Dr. Beard, who has had occasion to examine a very large number, speaks to me of regular epidemics of this kind of abnormality in some years in the past, the students in the laboratory experiencing great difficulty in distinguishing the males from the females.

The only published record, so far as I know, of additional genital openings in *Nephrops* is a recent paper by Mr. Cole, who states that "abnormalities in oviducal and spermatic apertures are by no means uncommon, and I remember examining three specimens, two of which were abnormal and had four supernumerary spermatic apertures occurring as follows:—

Third walking-legs. •
• • Fourth walking-legs. •
• • Fifth walking-legs. • •"

[1] Mr. Bateson informs me that he has noticed some variation in the degree of frequency of abnormality in regard to the oviducal apertures in batches of *Astacus* procured at various times for the Zoological Laboratory at Cambridge, and is of opinion that this variation is probably related to the localities from which the batches were obtained.

Mr. Bateson has, however, placed on record several cases of females of *Astacus fluviatilis* with additional oviducal apertures, but their degree of frequency was not nearly so great as that of the abnormal spermatic apertures in *Nephrops*. After citing Desmarest's observation of a female *Astacus* with oviducal apertures on both the antepenultimate and penultimate legs, to each of which the oviducts branched, he describes several cases that he has himself observed. Among 583 female *Astaci* he records 23 which were abnormal in regard to the genital apertures, 17 having an opening on one of the fourth legs, one with an opening on each of the fourth legs, one with one opening on each of the fourth and fifth legs (in each case in addition to the normal openings), and four in which one of the normal openings was wanting. The oviducts in most cases gave off branches to the abnormal openings as in Desmarest's specimen. Mr. Bateson cites Dr. Benham's observation on a female crayfish which had a pair of supernumerary openings on the fifth legs but none on the fourth. Out of 714 males that Mr. Bateson examined, one was abnormal in having no spermatic aperture on the right side. No cases of additional spermatic apertures are recorded for *Astacus*.

The above-described variations in *Nephrops* would appear to have some bearing on the supposed cases of hermaphroditism among the Astacidæ. La Valette St. George has described a specimen of *Astacus fluviatilis*, in its external characters a male, but with what appeared to be a hermaphrodite gland. Bergendal in two papers has recorded his observations on females of *Astacus fluviatilis* in which the appendages of the first abdominal somite were modified as in the male; and Faxon has cited other cases of partial or complete hermaphroditism. But it is only those cases where the evidence of hermaphroditism is supplied by the existence of apertures situated as in one sex, in animals which in many characters resemble the other sex, which specially concern the subject of this paper.

In his 'Revision of the Astacidæ' Faxon gives an account of a specimen of *Cambarus propinquus*, which appears to have been an undoubted female, for ovarian eggs were found on dissecting it. The external characters, including the condition of the appendages of the first and second abdominal somites, were also those of the female, with the exception of the position of the genital apertures, which were on the last pair of thoracic legs—*i. e.*, in the position typical of the male.

Lönnberg states that he believes he has seen rudimentary genital ducts passing to the third pair of thoracic legs in two specimens of *Cambarus fallax*, but owing to their state of preservation he is not positive.

Von Martens has long ago recorded the presence of additional apertures on the bases of the antepenultimate legs in certain male specimens of *Cheraps preissii*, *Astacus pilimanus*, and *A. brasiliensis*, the two latter of which are now included in Huxley's genus *Parastacus*.

Von Ihering describes these apertures which occur in all the

specimens of *Parastacus* he saw as follows:—"Il y a sur le coxopodite de la troisième jambe, une ouverture ovale qui est fermée par un écusson bombé et que l'on peut déprimer du côté médian ou libre." The state of preservation was not good, but von Ihéring says:—"Il m'a paru qu'un conduit très délicat se dirigeait plus en avant, à l'ouverture du troisième coxopodite, mais je ne puis l'affirmer." Whether or not the specimens dissected were hermaphrodite, von Ihéring is apparently also doubtful.

Faxon records the coexistence of both pairs of apertures in all the specimens he has examined of *Parastacus saffordi*, *P. varicosus*, *P. defossis*, and *P. hassleri*, but not in specimens of *P. agassizii*. No account of the internal genital organs is given by Faxon.

The best and most recent account of the supernumerary apertures and ducts of *Parastacus* is by Lönnberg, who describes both sexes, which differ not only in their internal but also in their external characters. The species described is *P. hassleri*. Not only do the males have supernumerary apertures and ducts in the 11th somite, but the females also in the 13th somite, in the position of the normal apertures of male crayfish. Although the supernumerary ducts have a lumen they are not functional, since the additional genital orifices in the male are only shallow grooves and those in the female are closed by a membrane. The additional openings in the male are closely similar in appearance to the functional openings of the female. Lönnberg states that he has found bodies resembling eggs in the testis, but he thinks it improbable that they "can be fully developed, still less of propagative use." He draws the conclusion that "in *Parastacus hassleri* a partial hermaphroditism is prevailing." It is interesting to note that the apertures in most species of *Parastacus*[1] are on the same somites as in the abnormal *Astacus* described by Benham.

In view of the frequent occurrence of genital apertures in *Nephrops* on the basal joints of other legs than the third and fifth, the coexistence of apertures upon these legs cannot be regarded as conclusive evidence of a partially hermaphrodite condition as some authors have supposed. Apertures on the fourth pair of legs have not, so far as I know, been recorded for *Parastacus*, but it is not unreasonable to suppose that if a large number of specimens were examined they would be found to occasionally occur.

To those who will regard the abnormal genital openings in *Nephrops* as evidence that the apertures and ducts were metamerically repeated in past times, all the above-cited cases must be interesting in view of Lankester's suggestion that the genital ducts of Arthropods are derived from nephridia. Allen has described the genital ducts in young adults of *Palæmonetes* as

[1] Mr. Borradaile has called my attention to the fact that in male specimens of *Pagurus deformis* M.-Edw. the female apertures also normally occur. *Vide* Borradaile, "On some Crustaceans from the South Pacific, Part II.," P. Z. S. 1898, where references are given.

agreeing "in all their relations with those of *Peripatus*," and the probability of their being derived from nephridia he regards as "very great." It is, however, very doubtful whether the case of *Nephrops* has any real bearing on this question, seeing that in *Astacus* we may also get variation in the direction of reduction of apertures, and in *Cambarus* simple homœotic shifting of the apertures without any addition to their number.

However this may be, the occurrence of such a high percentage of a particular kind of abnormality as I have recorded among the Norway lobsters of the Forth area during the present year is instructive as supplying another example of the falsity of the doctrine that a well-marked variation cannot exist with any considerable degree of frequency owing to the so-called "swamping effects of intercrossing."

Specimens illustrating the various arrangements of the genital apertures described in this paper were exhibited before the Zoological Section of the Meeting of the British Association at Glasgow.

In conclusion I must express my indebtedness to Mr. Bateson, by whom I was induced to undertake this investigation.

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2. On some remarkable Digestive Adaptations in Diprotodont Marsupials. By Dr. Einar Lönnberg, C.M.Z.S.

[Received November 18, 1901.]

(Text-figures 4–6.)

While dissecting for other purposes some Phalangerids, my attention was attracted by the great difference in the development of the intestine in the different species. As some of the observations made at the time are of a certain interest, the following account of the comparison of the conditions found in the different animals may perhaps be acceptable.

Before I proceed to report upon my own investigations, some preliminary remarks may be made concerning the views of other authors in similar cases.

The correspondence between an animal's diet and the development of the different parts of its intestine is a well-known fact; but, on the other hand, the reason why this must be so has been comparatively little discussed. Ellenberger, for instance, has stated that the great development of the cæcum in the Horse stands in connection with its diet, which chiefly consists of matter rich in cellulose. The food passes in this animal rather rapidly through the stomach and the small intestine, but is then retained in the cæcum, where, to a great extent, digestion and absorption take place. In his papers on Rodents, especially in his great work 'Ueber das System der Nagetiere,' Tullberg has expressed the opinion that digestion and absorption of cellulose take place in the cæcum and the colon. He says also that the digestion of this kind of food is not only dependent on the length and width of these intestinal tracts, but also on the slowness with which the food passes through these parts of the intestine. There are in fact to be found many structural adaptations for the purpose of retaining the food or retarding its passage. The same author also discusses the reason why some animals among the Rodents, viz. the Myoxids, have lost their cæcum. He believes that such a reduction is the result of a diet chiefly consisting of such

substances (amylum, fat, proteine), the digestion of which may take place in the small intestine without the help of any cæcum and without any specialization of the colon. Vegetable food may thus, just as well as a carnivorous diet, lead to the loss of the cæcum. He also draws attention to the condition found in the peculiar Phalangerid *Tarsipes*, in which the cæcum is entirely wanting, and thinks that this depends upon the fact that this animal feeds chiefly on honey. This last statement is of special interest because *Tarsipes* belongs to the same family as the animals which are to be considered here; and it might, with regard to the development of its intestine, be put at one end of the series described below.

The chief material for this little study was afforded by some specimens of *Phalanger maculatus* and *Petaurus breviceps*, collected in New Guinea by the late Dr. E. Nyman; a specimen of *Pseudochirus occidentalis* brought home from Western Australia by the late Captain Forsström; and a specimen of *Trichosurus vulpecula* from an unknown locality. In addition to these I have, with the kind permission of my friend Professor T. Tullberg, had the opportunity of using other available material in the Zoological Museum of the Royal University at Upsala, and I beg to offer him my best thanks for these new proofs of his never-ceasing liberality.

My first attempt was to try to find out on what kind of diet the above-mentioned animals lived, by carefully examining the contents of the stomach and the intestine. The stomach of the *Petaurus* contained pieces of the chitinous integument of various insects and larvæ, some whole Podurids, and hair of the animal itself. Among the Podurids my friend E. Wahlgren was able to distinguish specimens of *Isotoma palustris* and of an *Achorutes*. It seems accordingly to be certain that this animal may be termed entomophagous, although perhaps also berries etc. may enter into its diet. The stomach and the intestine of the *Phalanger maculatus* were completely filled with fruit-pulp, and there is thus reason to regard this Cuscus as chiefly carpophagous. The stomach in my specimens of *Pseudochirus* and *Trichosurus* was empty; the contents of the intestine and especially the cæcum indicated, however, a vegetable origin. In the cæcum of *Trichosurus* comparatively large pieces of the fibrous skeleton of leaves could be found, but the parenchymatous substance was digested or, at any rate, loosened from the "nerves." This agrees well with Lydekker's words—"the highly aromatic leaves of the Peppermint-gum form the favourite food of these animals."[1] The cæcum of *Pseudochirus* was filled with a substance in which, under the microscope, various parts of leaves, upper and lower epiderm, bundles of vessels, etc. could be discerned. There was also a good deal of fine sand, which, probably as dust, had once covered the leaves and sprouts on which the *Pseudochirus* had

[1] Lydekker: 'A Handbook to the Marsupialia and Monotremata.' London, 1894.

fed, and thus been swallowed together with the vegetable matter. *Trichosurus* and *Pseudochirus* are thus chiefly phyllophagous, and so also is the Koala (*Phascolarctos*), which feeds on Eucalyptus-leaves. Of the latter I have had only scant material—the dried cæcum of a grown animal and the intestine of a fœtus. It may, however, also be considered in this comparison because its anatomy is known from the descriptions of Owen [1] and Forbes [2].

For the purpose of illustrating the length of the different parts of the intestine, the measurements are given in the following table [3]:—

	Trichosurus.	*Pseudochirus.*	*Phalanger.*	*Petaurus.*
Length of animal without tail ...	39 cm.	28·5 cm.	58 cm.	14 cm.
Small intestine ..	213 „	189·5 „	198 „	48 „
Cæcum	23 „	42·5 „	69 „	5·5 „
Large intestine ...	122 „	87·2 „	261 „	11 „

To make the comparison easier it is, however, convenient to express the relation between the length of the different parts of the intestine and the length of the animal itself (without tail). This is done in the following table, in which the numbers indicate percentages of the length of the animal without tail. The numbers under the head of *Phascolarctos* are calculated from the measurements of this animal recorded by Forbes (*l. c.* p. 184). There are also added measurements taken by myself from a specimen of the small insectivorous *Acrobates pygmæus.*

In percentage of the animal's length without tail.	*Phasco-larctos.*	*Tricho-surus.*	*Pseudo-chirus.*	*Phalanger.*	*Petaurus.*	*Acro-bates.*
Small intestine ...	542	546	496	360	342	250
Cæcum	321	59	149	125	39	22·8
Large intestine ...	784	312	305	474	78	(mutilated)

A glance at this table reveals that in the Koala all parts of the intestine are very much more lengthened than the corresponding parts of the intestine of the animals at the other end of the series. The cæcum and the large intestine are considerably larger even than in the likewise chiefly phyllophagous *Trichosurus* and *Pseudochirus.* On the other hand, all three phyllophagous animals have the small intestine developed in comparatively the same degree but a good deal longer than in the others. The reason why the cæcum and the large intestine in *Trichosurus* and *Pseudochirus* are comparatively shorter than the same organs in the Koala may be seen from the description further on. If the digestion of the cellulose takes place chiefly in the cæcum, as has been supposed by the authors quoted above and with

[1] 'Anatomy of Vertebrates.'

[2] "On some Points in the Anatomy of the Koala (*Phascolarctos cinereus*)." P. Z. S. 1881, p. 180.

[3] All measurements are taken by means of a thread laid along the middle of the intestine while adherent to the mesentery.

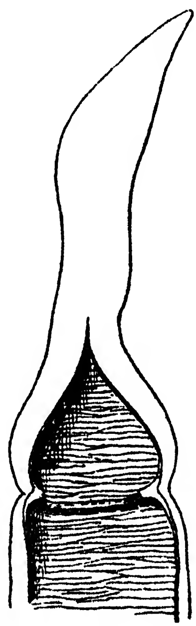
whom I fully agree, it may be asked—why has, then, the *small intestine* become lengthened in the three phyllophagous animals? I think that this may be explained in the following way:—The leaves of which the food of the animals is composed consist not only of cellulose, but contain also protoplasmic, amylaceous, and other substances, which ought to be digested and re-absorbed in the small intestine. These substances are, however, all of them enclosed within the membranes of the cellules of the leaves, and these membranes are more resistant than, for instance, the thin-walled cellules composing the pulp of fruit. The food derived from leaves must consequently be subjected to a longer treatment also in the small intestine, before yielding its useful substances, than food consisting of fruits needs—not to speak of animal food.

The small intestine of *Trichosurus* is villous, as has already been remarked by Oppel[1], but my material does not allow any description of the villi. About 93 cm. from the opening into the large intestine I have found two roundish Peyer's patches, situated near each other and measuring respectively 3 and 2½ mm. in diameter. They are solid and not composed of small nodules. In the intestine of the Koala there are no Peyer's patches according to Forbes (*l. c.* p. 184). The last portion of the ileum is in *Trichosurus* conspicuously more thick-walled than other parts of the small intestine. Its mucous membrane forms distinct longitudinal plicæ, and it seems thus to be more rich in glands than other parts. In addition to this there are to be seen what I am inclined to term, with Owen, some "wide and deep glandular fossæ." The largest of these is situated about 1 cm. from the ileo-cæcal opening, and measures nearly 5 mm. in length by 1½ in width. About 1 cm. higher up the ileum there is another one of the same kind although smaller, so that it measures only 2 mm. in length. There are also indications of some other depressions, but they are shallower and less distinct. My material does not allow of any histological investigations, but I hardly think I can be much wrong in interpreting these as accumulations of glands. The "fossæ" mentioned by Owen in the words quoted above were found by him in the large intestine of the Koala, and are thus not homologous with these. The "fossæ" found by Owen have, however, their homologue in a thickened glandular area, with numerous shallow depressions, situated on the adjoining borders of the colon and the cæcum of *Trichosurus* just opposite the ileo-cæcal opening. The ileo-cæcal valve is well developed and protrudes into the colon. The limit between the colon and the cæcum is only marked by a short plica from the ileo-cæcal valve and a weak *sphincter cæco-colicus*. If this sphincter is weak it is assisted in its functions by a series of cæcal sphincters which are strongly developed. Their number is four. The first is situated about 3 cm. from the cæco-colic one. The next is stronger and found at about the same

[1] 'Lehrbuch d. vergl. mikroskopischen Anatomie der Wirbeltiere,' Zweiter Teil (Jena, 1897), p. 288.

distance from the first. The third, which is almost the strongest lies still 4 cm. nearer the blind end. The fourth, which is about equal to the third in strength, is situated at a distance of about 8 cm. from the tip of the distal end. These two last-mentioned sphincters are 3½ to 4 mm. thick, and protrude in the preserved state, as circular valves 3 mm. or more, into the lumen of the cæcum; and there is no doubt that in the living animal they are capable of entirely shutting off one portion of the cæcum from the other, thus retaining the enclosed food during a suitable time

Text-fig. 4.



Cæcum of *Trichosurus vulpecula*. Nat. size.

for decomposition. The walls of the cæcum increase considerably in thickness towards its blind end; and it is evident that this increase includes the muscular coat as well as, and that especially, the glandular layer. This is the reason why the sphincters also must have an increased size and strength towards the blind end. The mucous membrane of the cæcum is, at least from the third sphincter and onwards, transversely plicated, the plicæ becoming more prominent towards the blind end. They do not extend, however, as simple plicæ all round the cæcum, but the ridges anastomose now and then so that they form a network with

transversely very much elongated, but longitudinally quite narrow, meshes.

The figure (text-fig. 4) represents the blind end of the cæcum from the last sphincter, and shows also the transverse plicæ described above.

When the cæcum is filled the blind end seems to taper to a point not unlike a vermiform appendix.

The colon is thin-walled and smooth, only showing, in places where it is contracted, longitudinal folds, which become effaced by stretching.

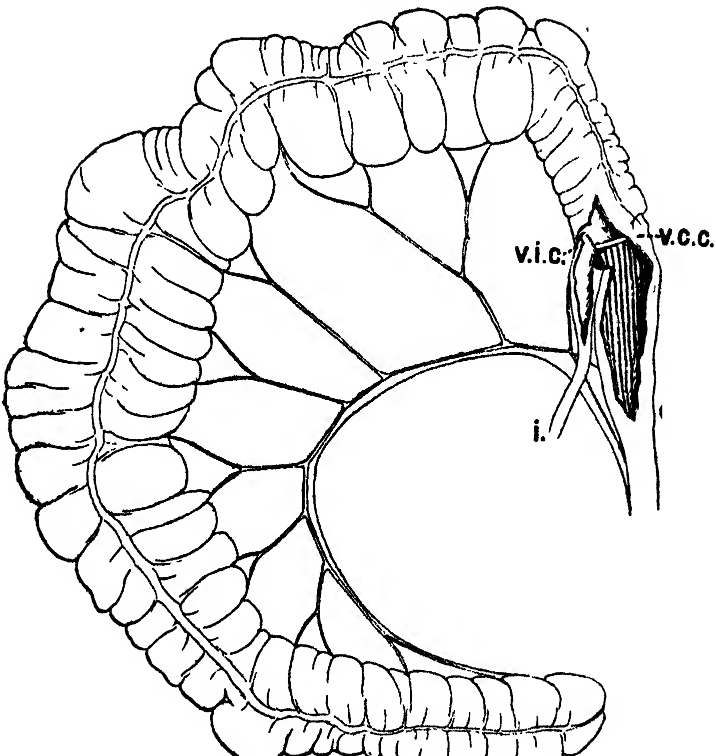
From this description it will be evident that the cæcum of *Trichosurus* is an organ which has become to a considerable degree specialized for digestion (and re-absorption). When the chyme passes through the terminal portion of the ileum it becomes mixed with the secretion of the glands of that intestinal tract, to which is added, when it enters through the ileo-cæcal valve, the secretion from the cæco-colic glandular patch. Thanks to the sphincters and the well-developed muscular coat of the cæcum, the food can be moved backwards and forwards, or retained in the cæcal divisions, and then be subjected to the action of the glands through the development of an increased surface due to the transverse plicæ. This great specialization gives a satisfactory explanation why the cæcum of *Trichosurus* does not need to grow out to such a size and attain such a capacity as that of the Koala. It might be questioned whether any proofs can be given to show that cellulose is really decomposed and digested in the cæcum of this animal. It may then, firstly, be referred to the peculiar structural specialization described above; secondly, it may be stated that the contents of the colon which have passed the cæcum seem to indicate such a digestion. There may still be recognized remains of the most resistant parts of the vegetable tissue, such as pieces of epiderm, isolated sclerenchym-cellules, bundles of vessels, etc.—all of them looking as if they had been cleaned by some reagent, so that only the hardest "skeletal" parts were left. There are also to be seen the spiral threads, these being the only remains of spiral vessels, the thin walls of which probably have been digested. But I could not detect any parenchymatous cellules or other softer parts. I think, therefore, that it may be admitted that the softer cellulose has been decomposed and digested, leaving only the more or less lignin-like substance.

In *Pseudochirus* the small intestine is, as usual, thin-walled and villous but otherwise smooth. The walls of the ileum do not seem to show any increase in thickness. The ileo-cæcal valve (*v.i.c.*) is well-developed, and from it extends as a transversal fold a cæco-colic valve (*v.c.c.*) and sphincter, as may be seen in the figure (text-fig. 5, p. 18).

Close by, but on the colic side and also near the ileo-cæcal valve, a brownish glandular patch is seen, homologous with that described above and in a similar situation in *Trichosurus*. (It is

not represented in the figure.) The cæcum of *Pseudochirus* is a good deal larger than that of *Trichosurus*, as the above-recorded comparative measurements indicate, and offers also quite another aspect (compare figures). It is provided with two very strong tæniæ, which continue to the blind end of the cæcum. These tæniæ have an average breadth of 3 mm. and extend one on each side. By means of these tæniæ and the mesentery the wall of the cæcum is folded so that it forms three series of sacculi.

Text-fig. 5.



Cæcum of *Pseudochirus occidentalis*. Nat. size.
c., colon; *i.*, ileum; *v.c.c.*, cæco-colic valve; *v.i.c.*, ileo-cæcal valve.

Through this the effectiveness of the cæcum as a digesting organ is greatly increased, the more so as the depth of the pockets is comparatively great. The end of the cæcum in this animal is bluntly rounded, and thus different from that of *Trichosurus*. The first part of the colon is longitudinally plicated, but the plicæ are not strongly developed and soon disappear.

The digestion in the cæcum seems to be rather complete, since at a distance of 25 cm., more or less, from the ileo-cæcal valve the fæcal matter is already formed into balls. A microscopical investigation of these fæcal remains shows that they are chiefly composed of pieces of thick-walled epiderm, bundles of vessels, isolated prosenchyme-cells, and similar matter. But the softer vegetable tissue has disappeared and the spiral threads of the vessels are isolated, indicating a digestion of the substance that once formed the walls.

The intestine of the Koala has been described, as already mentioned, by the authors quoted above. Only a few remarks will therefore be made here concerning the intestine of a marsupial fœtus of this species measuring about 9 cm. in length. Its small intestine measured about 37 cm., the cæcum 8·5 cm., and the large intestine about 29 cm. The length of the three different parts of the intestine, compared with the length of the fœtus itself, is thus expressed by the following percentages: 411, 94, 322. If these now are compared with the corresponding ones from a grown animal, calculated from Forbes's measurements (see above), the difference is quite striking with regard to the cæcum and the large intestine. The former is proportionately only about a third as long in the fœtus as in the full-grown animal, and the latter less than half as large in the fœtus as in the adult. The difference of the small intestine of both stages is not so great, that of the fœtus being about four-fifths of the same in the adult. It is also to be remarked that in the fœtus the small intestine is considerably longer than the colon, but in the adult the reverse condition prevails. These differences can of course be ascribed to the difference of the diet of both stages. The milk food of the fœtus is chiefly or completely digested in the small intestine, but the vegetable diet of the adult needs a greatly developed cæcum and colon. The longitudinal folds of the cæcum and the colon are, however, already developed in the fœtus.

The condition found in the Wombat is very peculiar. The narrow opening of the ileum protrudes, surrounded by an "ileo-cæcal" valve, into the colic cavity. This valve has very broad lips, and within the same opens the lumen of the "processus vermiformis" (Owen), only separated from the opening of the ileum by a septum—that is, in other words, the terminal portions of the vermiform appendage and of the ileum are thus fused together into one structure protruding into the colon; both open with separate orifices, which are, however, surrounded by the lips of the same valve. The glandular patch described above as situated near the *valvula cæco-colica* in the related Phalangerids is found in this animal too, but extends partly on to the outer side of the "ileo-cæcal" valve itself already mentioned. From this latter valve plicæ extend on two sides. These plicæ seem to stand in the same kind of connection to the ileo-cæcal valve as in normal cases the cæco-colic valve does. But they do not extend

transversely in the colon as the latter is apt to do, but longitudinally, so that one plica extends down the colon, the other in an opposite direction on the other side. I am, however, inclined to think that these plicæ morphologically correspond to the more or less developed cæco-colic valve of other related forms. Although the direction is different the connection with the ileo-cæcal valve may decide in favour of such an interpretation. These plicæ do not form any boundary between the cæcum and the colon. They form no boundary at all directed as they are now. But how could they get such a direction? I think this may be explained in connection with the shape of the cæcum. Owen, in describing the intestine of the Wombat, used the following words:—"The cæcum is extremely short but wide; it is remarkable for being provided with a vermiform appendage."[1] Later authors have adopted this same interpretation, but I hardly think it is right. If it had been a true vermiform appendage, that is, the reduced blind end of a cæcum, it ought to have opened into the cæcum of which it itself was a part. But it does not, as has been already stated above. It opens with a quite independent opening of its own near that of the ileum. I judge from this that the so-called *processus vermiformis* of the Wombat *represents a rudiment of the whole cæcum.* If we assume that a moderately developed cæcum should for some reason or another become reduced to a mere appendage, it must acquire a similar situation and open into the colon close to the ileum. It might then easily happen that the wall of the terminal portion of the rudimentary cæcum became fused with the wall of the ileo-cæcal valve. Such an event might be the more easily effected as the shortened mesentery of the cæcal rudiment would draw the latter more and more to the ileum and make both more closely connected. It would also be more convenient if the two openings into the colon lay near each other and were parallel in direction, because there would then be less risk of particles of food entering the cæcal rudiment. I believe, indeed, that such a retrograde development has really taken place, and that in the ancestors of the Wombat the cæcum has been reduced to a rudiment, which might happen if they lived on such a diet that the cæcum was not needed for the digestion of the food. When the cæcum had already reached a considerable degree of reduction, the diet of the animals was changed, and they began by-and-bye to feed on harder and less easily digestible vegetable matter containing cellulose, etc. The cæcum was now, however, so rudimentary that it could not, as in other related forms which live on a similar diet, help in the digestion of this food-stuff. This function became, therefore, the duty of the colon alone, which in consequence had to be considerably enlarged. It grew in strength, and its capacity increased so that it would be able to hold the greatly augmented amount of the less nourishing food that was needed for the sustaining of life and growth. The colon was then distended by the large quantities

[1] Owen: 'Anat. of Vertebr.' p. 417.

of food-material, and the mechanical pressure of this heavy load might have produced expansions, which, if localized, formed bags or sacculi. The first part of the colon might be expected to have been strongly affected by this pressure. It is consequently natural that some wide sacculi should be formed there, and it is these distensions which have been described and figured by the authors as cæcum, although they are derived purely from the colon. It is also easy to understand that when this distension took place the originally transverse cæco-colic plica was drawn or turned out of place to its present longitudinally-running direction.

That the mechanical pressure of the contents of the colon has really played important parts in transforming it to its present shape, may also be proved by another fact. By a broad band opposite the mesentery the colon is sacculated, which, of course, is also an adaptation to its function. At the place where the colon is most closely, by a very short mesentery, soldered to the back of the abdominal cavity, the pressure of the contents would, thanks to this fixation, be more effective. There has thus been formed two large sacculi, which give the colon at that place a size amounting to twice that of its usual width. The shape and size of these sacculi are identical in two specimens which I have seen. This confirms the correctness of the statement; and I think it is these which Owen means when he says: "One of these sacculi was so much longer than the rest as to almost merit special notice as a second cæcum."

Peyer's patches of comparatively large size, 1 to 2 cm. in diameter, are scattered in considerable numbers in the walls of the colon, especially in its middle parts.

The material which I have used for this study has long been preserved in spirit, and the measurements are perhaps therefore not so much to be relied upon. It may, however, be mentioned that the small intestine measured in one specimen about 410 cm., the cæcal rudiment 6 cm. from its blind end to its opening, and the large intestine 840 cm. The "secondary cæcum" is situated nearly at the middle, or 430 cm. from the end. Even if these measurements are imperfect in the detailed statements, they show satisfactorily that the large intestine has been strongly developed. Probably it is fully eight times the length of the animal, or even more than in the Koala.

The interior surface of the duodenum in *Phalanger* shows very plainly a reticulate structure, larger primary and smaller secondary plicæ may easily be distinguished. It offers thus some faint resemblance in appearance to the structure of the reticulum of a ruminant. The plicæ are in both cases formed by coalescence of papillæ. The villi of the intestine are well developed on the ridges forming the network, but some are also scattered in the interspaces. Lower down the small intestine this reticulate structure is less conspicuous, but my material is not in such good condition that I can say where it entirely disappears. The jejunum appears, however, quite smooth.

As in *Trichosurus*, the small intestine of *Phalanger* is provided with at least one Peyer's patch. It is in the specimen before me situated 74 cm. from the cæcum, and measures 30 mm. in length by 13 in breadth, being composed of a great number of small nodules. There are, however, probably more than one Peyer's patch normally in the small intestine of the Cuscus, since Cunningham observed no less than nine in his specimen described in the 'Challenger' report. Some of these were, however, "a mere speck." The terminal portion of the small intestine shows some longitudinal folds, but these are probably not permanent as they disappear by transverse stretching. The ileo-cæcal valve is well developed and protrudes 12 to 14 mm. into the cæcum. From this valve extends on both sides a fold—the cæco-colic valve. At the ileo-cæcal valve it is about 7 mm. in height, but gradually diminishes; about 1 cm. from the valve it passes into the muscular thickening which forms the cæco-colic sphincter. The communication between the cæcum and the colon may thus be completely shut off by means of the incomplete cæco-colic valve and by contraction of the cæco-colic sphincter. When such a shutting-off is effected it seems as if the opening of the ileo-cæcal valve would be directed into the cæcum, and the function of the above-described cæco-colic valve may partly be to brace the ileo-cæcal valve so that it shall not be compressed and closed when the cæco-colic sphincter contracts. But, as it is arranged now, the contents of the small intestine may pass directly into the cæcum without risk of slipping down into the colon. On the cæcal side of the valve there is an area on which the mucous membrane is provided with a considerable number of small depressions. These are about 1 mm. in diameter, and correspond, no doubt, to the glandular patch with similar depressions which has been described above in the phyllophagous Phalangerids, although the situation is a little different in these latter, in which this patch is found on the colic side of the valve. Cunningham does not mention this glandular patch in his description of the intestine of the Cuscus.

The width of the cæcum is different at different places. It is at first about 4 cm., then widens to 6 cm., but soon becomes constricted to only 2½ cm., widens again to 5½ cm., then it is constricted to 2½ cm., and again widened to 4 cm., which condition is once more repeated, and then it finally tapers towards the end, which terminates in a digitiform appendix 2 cm. in length by 4 mm. in thickness. Cunningham[1] has in the same species only observed that the cæcum "tapers uniformly." The appendix is hollow and filled with the contents of the cæcum. Its walls are thicker than those of the ordinary cæcum, and it might be a lymphatic organ, which perhaps might be compared with the one of similar situation in the common rabbit.

The cæcum of *Phalanger* is somewhat sacculated by means of

[1] "Report on the Marsupialia," Rep. Scient. Results 'Challenger,' Zoology, pt. xvi. p. 161.

mesenteric bands of muscular fibres which are most often longitudinally, but sometimes obliquely, arranged. Such bands are found on both sides of the cæcum. The interior of the cæcum shows at the constricted places slight longitudinal folds, which, however, probably are of a temporary nature. They are thus not to be compared with the longitudinal folds described in the Koala by Owen and Forbes (*l. c.*).

In the large intestine of *Phalanger* there are some longitudinal folds near the upper sphincter. They are, however, quite short and continue but a few centimetres from the ileo-cæcal valve, and are therefore quite unlike the longitudinal "*valvulæ conniventes*" described in the Koala by the authors just mentioned. The colon tapers abruptly from the width of the cæcum $4\frac{1}{2}$ cm. to $2\frac{1}{2}$ and then to $1\frac{1}{2}$ cm. In places where it is much distended its width may reach 3 cm., but as a rule it is less than that of the small intestine, usually $2–1\frac{1}{2}$ cm.[1] The rectum attains a width of $2\frac{1}{2}$ cm., and is provided with about half a dozen longitudinal folds, plainly conspicuous, but not much developed. They may, however, be regarded as homologous with those of the Koala in a corresponding situation and of nearly the same number, according to Forbes. The non-digestible remains in the colon of *Phalanger* consist of pieces of epiderm of fruit, prosenchymatous fibres and vessels. The main mass of the fruit-pulp is, however, so decomposed that its particles cannot be identified.

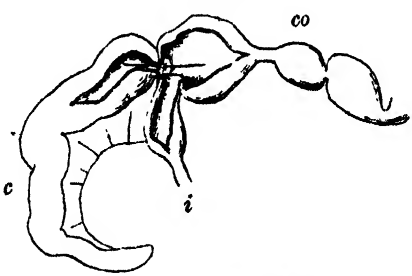
The duodenum of *Petaurus* is very densely beset with flattened more or less tongue-like villi which are transversely arranged and partly form thin denticulated lamellæ. They lie so close together that the contents of the intestine probably only, or at least chiefly, come into contact with the tips of the villi—a condition found by Oppel (*l. c.* pp. 288–9) in *Trichosurus*. In *Petaurus* the small intestine is beset with villi through its whole extent, although they decrease in size posteriorly. The condition found in *Acrobates* seems to be essentially the same. In *Petaurus* the duodenum forms a much more distinct loop than in *Phalanger*; it is 3 cm. in length, the ascending branch being closely connected with the descending one and returning along the same to the pyloric tract. In the latter the duodenal loop is less pronounced because the ascending branch is only half as long as the descending one.

In *Petaurus* the connection between the large and small intestine takes place in such a manner that the ileum opens *into the colon*, into which the *valvula ileo-cæcalis* (the name is thus not quite suitable in this case, more correctly *v. ileo-colica*) protruded about 2 mm. Close to this valve there is between the cæcum and the colon a strong sphincter, partly like a valve protruding into the cavity of the colon and only leaving a very narrow opening (which, of course, also can be closed) between the same and that of the cæcum.

[1] All such measurements are taken across the empty but not opened intestine.

It is thus evident that the contents of the ileum must pass into the colon, and from there, when the sphincter mentioned above relaxes, into the cæcum. It is also evident that no large pieces can pass through the narrow opening into the cæcum. A comparison between the contents of the colon proves this statement completely. A sample of the contents of the colon taken 2 cm. from the ileo-cæcal valve consists chiefly of large pieces of the chitinous integument of insects, setæ of such animals, etc. A sample from the cæcum consists only of the tiniest particles which cannot be measured or identified. The narrow opening between the cæcum and the colon serves accordingly as a filter. The large indigestible remains are kept back in the colon, the fluid and the fine particles suspended in the same pass into the cæcum, where, no doubt, an absorption of the fluid takes place, after which the indigestible remains are forced back to the colon to be expelled with the fæces. The function of the cæcum may thus be termed absorbing and desiccating. The large intestine acts nearly in its whole extent as a rectum, as the fæcal matter is already formed into balls at a distance of only 2 cm. from the ileum (text-fig. 6).

Text-fig. 6.



Cæcum of *Petaurus breviceps.*

c, cæcum; *i*, ileum; *co*, colon. *Valvula ileo-colica* is seen to protrude into the colon, and a bristle is inserted through the narrow opening of the cæco-colic sphincter.

In *Phalanger*, on the other hand, it can be assumed with certainty that the cæcum has a digestive function, which may be concluded from the fact that it is provided with large glands. The great length of the colon makes it probable that it has digestive as well as reabsorbing powers.

The dimensions of the different tracts of the intestine in a marsupial young of *Petaurus breviceps*, measuring 63 mm. in total length without tail, were as follows:—Small intestine 185 mm., cæcum 17 mm., and large intestine 43 mm. If these measurements be compared with those of the young animal itself (without tail) the relation is expressed by the following percentages:—290, 26, and 68. From this it may be seen that all three parts are

somewhat shorter in the young than in the adult. The difference is, however, not so great as in the case of a marsupial fœtus of the Koala already mentioned. Although the latter represented a younger stage [1], the conclusion can thus be drawn that the milk diet of the young *Petaurus* differs, with regard to its composition and therefrom resulting influence on the intestine, less than it does in the case of the young Koala. It is also of interest to note that in the young *Petaurus* the cæcum stands in quite open communication with the colon. That is because the sphincter is not needed yet for the purpose of prohibiting any indigestible remains from entering the cæcum as in the adult.

In *Acrobates* the arrangement of the connection between the small and the large intestine is the same as in the adult *Petaurus*. The ileum opens with its valve protruding like a mouthpiece into the colon; and there is a very strong constriction between the latter and the cæcum. Although the stomach in my specimen of *Acrobates* was empty, I think it may be assumed that it lives on a similar diet to *Petaurus*; and at any rate the function of the cæcum seems to be perfectly alike in both animals.

The small intestine of *Acrobates* is comparatively shorter even than that of *Petaurus*. In the latter and in *Phalanger* the length of the small intestine is comparatively not much different. This may be understood as meaning that that part of the food-material which ought to be digested in the small intestine of *Phalanger* is not difficult to digest. It may chiefly consist of the juice and other contents of the soft parenchymatous cells of the fruit-pulp. This matter is, of course, more easily accessible for the digestive organ than is the material contained in the better protected cells of the leaves etc., which form the food of the animals considered above, and the small intestine of which, therefore, has become lengthened.

As the last stage in this series, showing a different development of the intestine and especially of the cæcum in accordance with the different diet, *Tarsipes* may be mentioned; this animal has, as already remarked, entirely lost its cæcum, because such an organ is superfluous for a honey-eater.

The general arrangement and structure of the dentition of these animals indicate that also with regard to those parts adaptations for different purposes have taken place. The dentition of *Phascolomys* is evidently most specialized. Its incisors are more reduced in number than in the others, the canines are absent, and the molars have persistent pulps. The latter are also curved in such a way that the upper molars are laterally concave and the lower ones are laterally convex. This development and shape

[1] The Koala fœtus was still naked. The young *Petaurus* was beginning to become hairy, so that, for instance, the dark vertebral stripe was well conspicuous, but the hairs of the tail were not yet prolonged. It had certainly not yet partaken of any other food than milk, because the mandibular incisors, although protruding 3 mm. from the sockets, had not cut the gum.

of the molars reminds one of the same in the Hares and Rabbits. In his above-quoted work Tullberg has already drawn attention to this parallelism. The explanation given by that author of the development of persistent pulps in the molars holds good for the Wombat as well. He believes that such teeth have been developed chiefly in animals which feed on hard and tough roots. Such animals must take much sand into the mouth when feeding, and the sand must act strongly upon the crowns of the molars in the act of grinding. This renders persistent growth necessary. That the food of the Wombat consists mainly of roots is a well-known fact; and a glance at the crowns of the molars suffices to show the marks of the sand as transverse scratches. Although the molars of the Wombat in their general shape resemble those of a Rabbit, the chewing must take place in quite a different manner in both forms [1], as can be seen from a comparison of the structure of the mandible in both animals.

The dentition of the Phalangerids has been described by Flower and Lydekker in their valuable manual [2]. They have drawn attention to the "crescentoid" cusps of the molars in *Pseudochirus* and in the Koala "recalling those of the Selenodont Artiodactyle Ungulates." This "subselenodont" dentition is, of course, very suitable for phyllophagous animals. It becomes the more effective because the distance between the upper molar series is greater than that between the mandibular molar series, so that the outer row of cusps of the latter fit in between both rows of the upper. Through this arrangement the jaws get as it were a cutting-power, and when the lower jaw is moved sideways the sharp enamel ridges have a great power of tearing and grinding the food. It is, in fact, evident that the chewing of the food takes place in the following manner:—The lower jaw is moved towards one side so much that the outer margin of its molars corresponds to the outer margin of the upper molars. If, then, both jaws are pressed hard against each other the lower jaw must glide, with triturating effect, in a median direction—in consequence of the fact that the main surface of the upper molars slopes inward—till the outer cusps of the lower molars fit in between both series of cusps of upper molars as described above. Then the same movements are repeated again on the same or the other side. The movements of the jaws in the act of chewing may thus be compared with those in the Ruminants —as might be expected seeing that the teeth have a similar structure and position.

The incisors in these two animals are different in shape. In the Koala they are comparatively narrower than in *Pseudochirus*. The compressed mandibular incisors glide with their bevelled ends inside the upper median incisors, and work against the second pair of upper incisors; the latter in their styliform shape

[1] This is also remarked by Tullberg (*l. c.*).
[2] An Introduction to the Study of Mammals. London, 1891.

and situation behind the first pair remind one of those of the duplicidentate rodents. The incisors in this animal serve thus to nip off pieces of the leaves. In *Pseudochirus* the lower incisors are broad and have sharp cutting-edges also on the sides. They therefore work together with the upper incisors as a pair of scissors cutting off pieces of plants and leaves. Both halves of the mandible are in this animal movable, whereby the cutting-power of the lower incisors becomes more effective. They may thus be compared in shape and in action with those of the Kangaroos.

In *Trichosurus* the incisors are intermediate in shape between those of the two animals just referred to. They are broader than in the Koala, but have a cutting-edge only in front. In two skulls of this animal before me it is plain that the lower incisors, when used, are able to work against all three pairs of upper incisors, which are all worn—the median ones, however, in such a manner that a sharp edge is left in front. The two halves of the mandible do not seem to be movable.

The subselenodont type of the molars is not so prominent in this animal—at least not when the teeth are worn. The shape and position of the molars seem also to be different in *Trichosurus*, because, at least in the specimens before me, the surface of the two anterior upper molars slopes inwards and that of the two posterior ones outwards. In the lower jaw, in correspondence herewith, the two anterior molars slope outwards and the two posterior ones inwards. The crown of the posterior premolar in each jaw slopes in the same direction as the anterior molars of the same series close to which it is situated. In consequence of this arrangement, the upper premolar and the anterior upper molars effect the gliding in a median direction of the lower jaw when both jaws are pressed against each other in the manner described above; but the posterior upper molars arrest the lower jaw and hinder it from gliding further than to its normal position. In connection herewith is also to be observed that the mandibular molar series of *Trichosurus*—thus differing from the Koala and *Pseudochirus*—have not a shorter distance *inter se* along their whole length than the maxillary molar series. In *Trichosurus* the molar series of both jaws are, posteriorly, almost opposite each other, and only anteriorly have the mandibular molars a more median position than the upper molars. This accounts for the different direction of the anterior and posterior molars.

The teeth of a young *Phalanger* differ a great deal from those of the old one of the same species. In the half-grown animal the lower incisors appear to be absolutely broader than in the adult. This is, however, only apparently the case. The breadth is about the same in both. The incisors of the young are thus not only comparatively broader, but their shape is also different. They are much more flattened than in the adult and have sharp lateral edges, so that they resemble the corresponding teeth of *Pseudochirus* described above, or of a Kangaroo. The resem-

blance is the greater because they have a more horizontal direction than in the adult, in which latter they are also stouter, compressed, and only provided with an edge at the end. In the young the lower incisors, on account of their shape, work against the two median pairs of the upper incisors when the jaws are shut. In the adult they work only against the inside of the median pair of upper incisors when in a normal situation close to each other. The halves of the lower jaw are, however, movable, more so in the young than in the adult. This, together with the sideway movements of the lower jaw, explains also why the second pair of upper incisors are worn. The faculty of moving the mandibular halves so that the lower incisors may be separated from each other in the act of biting is, of course, very useful in many cases[1]. Thus, for instance, the animal is capable of securing a much larger piece of some soft fruit[2] in one bite through this arrangement, and when occasionally preying upon animals or birds this faculty is also of importance. The mobility of the mandibular halves consequently serves here other purposes than in the Kangaroos and *Pseudochirus*.

The upper canines are well developed in young and adult. The molars of the young Cuscus show four well-developed pyramidal cusps with radiating ridges, so that, as has been shown by O. Thomas, they resemble in some degree those of the Koala. The enamel of these cusps is, however, less developed in the Cuscus, so that they are in the adult animal soon worn down to such an extent that the crown becomes almost even, and only peripherally surrounded by enamel. The teeth are then not much adapted for any grinding action. The situation and different sloping of the posterior and anterior molars are similar to those described in *Trichosurus*. The action of the jaws must consequently be similar, although the enamel is rather less developed. To crush the pulp of fruits and similar matter the teeth are, however, sufficient. The hindmost premolar of both jaws lying just in front of the molar series is somewhat more strongly developed than in *Trichosurus*, pointed and reminding one a little of a canine. Those of the upper and lower jaw do not touch each other as in *Trichosurus*, but the mandibular premolar goes inside and in front of that of the maxillary. This development of the last premolar may have some connection with the alleged occasionally predatory habits of the animal.

In *Petaurus* the median lower incisors are very long and slender. The median pair of upper incisors are longer than the others. They may thus, together with the lower incisors, form a pair of pincers. It is also probable that the mandibular incisors themselves may, because both halves of the lower jaw are quite movable, act as a suitable implement for pinching and scratching

[1] The mobility of the mandibular halves of the Rodents and its causes have been extensively discussed by Tullberg in his work quoted above, p. 345 and following.

[2] Tullberg has stated that Squirrels feeding on mushrooms separate their incisors (*l. c.*).

small insects from their refuge in flowers, in cracks in the bark, and similar places where these slender incisors may conveniently be inserted. When securing larger insects this can, of course, be more easily done with the incisors separated so that they act as a fork, than if they lie close together and form only one point. The molars have four moderately developed bluntly pointed cusps. The lateral row of cusps of the mandibular molars fits in between both rows of cusps of the upper molars.

On the whole the dentition may be said to approach the insectivorous type. The molars can certainly not be used for the grinding of any hard vegetable matter, and the incisors are too weak to gnaw.

In *Acrobates* the development has gone still further in the same direction. The median lower incisors are long and slender, although, if compared with the skull itself, not so long as in *Petaurus*, which has a shorter, less pointed snout. They may certainly serve as pincers and the mandibular halves are quite movable. The premolars of *Acrobates* are much better developed, longer, and more pointed than those of *Petaurus*. When the jaws shut, the premolars of the upper and lower jaws meet, and the latter slide up in front of the former. These teeth may thus help in catching and holding the prey, which is not the case in *Petaurus*. In the latter the premolars and second incisors of the lower jaw are small and functionless. This is because, in consequence of the length of the median incisors and the corresponding shortness of the jaw itself, there is formed a considerable opening between the upper and the lower jaw corresponding to the canine and premolar region of the maxillary. The maxillary teeth thus cannot meet the mandibular teeth, which do not even lie opposite to them. The molars of *Acrobates* are similar to those of *Petaurus*, but their cusps are sharper. It may be in consequence of the arrangement of the premolars and their use that *Acrobates* has been able to reduce its number of molars to 3/3 when *Petaurus* has 4/4.

In none of the Phalangerids which have the rami of the lower jaw movable, as described above, have I been able to detect in my material any trace of such a transverse muscle as that which is found in the Kangaroos at the base of the mandibular incisors, and which has the function of approximating the inner edges of these teeth. In the Kangaroos it is said by Leche[1] that the mandibular incisors are separated from each other by the combined action of the *musculi biventer*, *mylohyoideus*, and *geniohyoideus*. In his great work on the Rodents already quoted, Tullberg states that *m. masseter* serves to break or bend the lower margin of the mandible outwards, and that in such a case the incisors become pressed close to each other. On the other hand, the *m. transversus mandibulæ*, when contracting, approaches the lower margins of the mandibular rami towards the median line,

[1] Bronn: Kl. u. Ordn. d. Thierr., Saügethiere, vi. 5. 1. p. 681.

whereby the incisors become separated. In the Phalangerids in question I think that in a similar manner as in the Rodents the *masseter* may press the mandibular incisors together, but the *pterygoideus internus* separates them from each other. The *mylohyoideus* seems to be rather weak, and is inserted too high up on the inner surface of the mandible to have any power of bending the lower parts of the mandibular rami inwards and thus separate the incisors. The *pterygoideus internus* is very strongly developed, and the angle of the mandible is much inflected so as to give this muscle a wide area of insertion. It is of interest to see that in those Phalangerids which have especially movable mandibular rami, viz. *Pseudochirus*, *Petaurus*, and *Acrobates*, this inflexion is much stronger than in the Koala with fixed mandibular rami. This fact gains importance by the observation that in the three former less is done for the enlarging of the area of insertion of the *masseter* on the outer side of the mandible than in the Koala, in which the angle is considerably expanded on the outer side.

In *Trichosurus* and the Wombat, with immovable mandibular rami, and in *Phalanger*, with the same only a little movable, the angle of the mandible is broadly expanded on both sides for the purpose of giving the powerful muscles a wide area of insertion.

It has been stated above that the Koala and *Pseudochirus*, and in a somewhat smaller degree *Trichosurus* and *Phalanger*, must move their mandibles in a lateral direction in the act of chewing, so that the mandibular molars come quite opposite those of the maxillary. This movement must take place in such a manner that the whole mandible makes a slight lateral rotation with the condyle of the same side, towards which the movement is directed, as a fixed point or pivot. This rotation is effected by the contraction of a portion of the *masseter* of the opposite side, that portion which, posteriorly, is inserted to the outer angle of the mandible, and anteriorly to the foremost part of the zygomatic arch or to the maxillary below and in front of the same.

When contracting, this muscle endeavours to pull its posterior point of insertion forwards, which results in a pressing of the whole mandible towards the other side. The result is the more easily obtained the more the outer angle of the mandible is developed, because the lever becomes longer when the posterior point of insertion of the said massèteric portion is situated more laterally—or, which is the same, at a greater distance from the pivot (condyle). The *m. pterygoideus internus* when contracting endeavours to draw up the lower margin of the mandible, or its inner angle, in an upward and somewhat median direction. This action then results in an outward bending of the molar series, and, perhaps, also a slight lateral rotation of the whole mandible, because it is fixed posteriorly. The more the inner mandibular angle protrudes in a median direction, the longer is the lever for

this muscular action. It is thus possible that the movement of the mandible towards one side is effected by the combined action of a part of the *masseter* of the opposite side, and in less degree by the *pterygoideus internus* of the same side. When the mandible has come to the desired lateral position so that the outer margin of its molars comes quite opposite that of the corresponding molars of the maxillary, both *masseters* and *pterygoidei* contract and press the jaws together. The lower jaw then glides back into the normal position, owing to the direction of the sloping surfaces of the molar crowns as described above.

In the true Phalangerids the mandibular condyle which serves as the pivot in the above-mentioned lateral rotation of the lower jaw is steadied behind by the very solid post-glenoidal bone. In the Wombat the condyle is only steadied on the inner side. We may conclude from this that the chewing of this animal takes place in a different manner from that in the true Phalangerids. The sloping of the molar surfaces is also quite different in the Wombat, *i. e.* inwards in the lower and outwards in the upper jaw. In addition to this they are concave with sharp enamel ridges all round, but especially protruding at the inner and outer margins. It seems as if the chewing were effected by alternating transverse movements of the lower jaw, and that the triturating action on each side chiefly takes place when that side of the mandible is moved in a median direction. As my material is not sufficient, however, I shall not make any detailed statements.

Tarsipes takes, with regard to its dentition, the same extreme position as it does with regard to the development of its intestine. The mandibular incisors are slender and form together a point, which perhaps might be used in making holes in the corolla of flowers rich in honey for the insertion of the tongue. Together with the upper incisors and canines they may also act as a pair of pincers, useful when the animal catches small insects as it is reported to do [1]. But the well-known rudimentary condition of its molar series—in the specimen before me 2/2 to the left, 3/3 to the right—as well as the weakness of the lower jaw, without a *processus coronoideus* and angular inflection, make chewing or even crushing of any hard prey impossible.

Thus the development and structure of the dentition, as well as of the intestine, show a beautiful correspondence with the diet and habits of the animals in the whole family Phalangeridæ, the more striking through the polymorphism within so restricted limits as those of such a natural group.

[1] Conf. Lydekker's 'Handbook,' p. 121 (quoted on p. 13).

3. On the Specimen of the Quagga in the Imperial Museum of Natural History, Vienna. By LUDWIG v. LORENZ, C.M.Z.S.

[Received November 25, 1901.]

(Text-figure 7.)

In the Zoological collection of our Museum there is a striped *Equus* named "*Equus quagga*," and until recently I have always thought it was a Quagga of typical features, though the published figures of that now extinct animal are rather different. But when I visited the museums of Munich, Tring, London, Paris, and Berlin last year, I discovered that the Quaggas which I saw there were not quite in accordance with the specimen at Vienna. I noticed them to be in general of somewhat *different coloration*—more greyish or chocolate-brown on the upper parts, to have *narrower* and perhaps more numerous dark stripes separated by comparatively *broader* light interspaces, and, moreover, they all appeared to be of a *smaller* size. When I returned to Vienna I asked my friend Marktanner (of the Museum in Graz) to photograph our Quagga, and I had intended to send copies of the photograph to different museums and to get others of the Quaggas there in exchange. But different circumstances prevented me from following the matter up until October last, when I had the pleasure of receiving a visit from Dr. P. L. Sclater; and one of his first questions was, what I thought about our Quagga, as it seemed to him not quite identical with other specimens of this *Equus* known to him. It was a great satisfaction to me that such an authority as Dr. Sclater had come to the same conclusion as I had done, and I am following his invitation in offering to the Zoological Society of London an exact description of our Quagga accompanied by one of the before-mentioned photographs. Before writing this I examined the following figures of the Quagga, which I propose to refer to as I proceed with my description:—

Fig. I.—Buffon's and Shaw's copies of Edwards's plate (Gleanings of Nat. Hist. i. pls. 222 & 223)[1], though this figure seems to me to represent rather *Equus burchelli*.

Fig. II.—Buffon's and Schreber's copies of Allamand's young Quagga. (Allamand's edition of Buffon, Supplément, v. pl. vi.)

Fig. III.—Geoffroy St.-Hilaire and Cuvier's plate (Hist. Nat. Mammif. pl. 320), also reproduced by Schinz (Säugethiere, "*Equus*," pl. v.).

Fig. IV.—Schreber's plate (vol. vi. pl. 317 A), representing the Quagga of Munich acquired by Ecklon about 1835.

[1] Taken from the type of *Equus quagga*.

Fig. V.—The woodcut in Flower and Lydekker's 'Animals Living and Extinct,' p. 384, fig. 160; copied in W. L. Sclater's 'Fauna of S. Africa,' Mammals, ii. p. 295, fig. 74.

Fig. VI.—A woodcut in Brehm's 'Thierleben, Säugethiere,' Bd. iii. fig. p. 49.

Fig. VII.—Noack's drawing (Zool. Garten, 1893, fig. p. 293), taken from the figures in the 'Gleanings of the Knowsley Menagerie,' pl. liv.

Fig. VIII.—The woodcut in Lydekker's 'Royal Natural History' (vol. ii. fig. p. 507), perhaps representing the specimen now in the British Museum.

Fig. IX.—The portrait of a Quagga's head in Bryden's 'Great and Small Game of S. Africa,' pl. ii. fig. 2.

Fig. X.—Copies of York's photographs (P. Z. S. 1901, i. p. 166, fig. 47) of the Quagga in the Society's Gardens in 1870, and two photos of the same animal kindly sent to me by Dr. Sclater.

Fig. XI.—An original photograph of the Quagga in the Museum at Tring, being the same individual as the last (no. x.).

Text-fig. 7.

The Quagga of the Vienna Museum. (From a photograph.)

Description of the female Quagga purchased by Ecklon, 1836 (Mus. Vindob.).

Remarks on the Description.

Measurements in centimetres:

Total length from upper lip to end of tail, without hair ...	300
Length of the face from nostrils to the beginning of the mane........................	43
Length of the mane...........	76
From end of mane to root of tail	128
Tail without hair	40
Tail with hair	80
Length of ears on the outer side.............................	22·5
Ditto on the inner side	15
Height at the withers.........	130
Height at the croup............	139
Fore leg from the elbow	71
Hind leg from the heel	52
Hoofs, length	6·5 & 6
Circumference of hoofs...	23 & 27

Of all the Quaggas figured as above noted the authors give generally smaller measurements, and the specimens examined by me were all apparently smaller.

Coloration:

Ground - colour of upperside clay-brown on the head, creamy buff on the neck, shoulders, and back, gradually changing to buff on the flanks and thighs.

Of the figures above cited only figure iii. comes generally near the colour of our specimen, but it is still lighter. Fig. iv. approaches it too, but is darker on the back. In fig. i. the ground-colour is pale chestnut.

Breast, *underparts*, *legs*, and *tail* white. Tail with elongated hair from the root. *Head*, *neck*, *back*, and *flanks* with narrow or broad stripes of yellowish brown passing into chestnut or maroon. Back (haunches) clouded with drab. *Mane* in the middle dark chestnut, ornamented laterally by tufts of whitish hair, ten on each side.

The stuffed specimens seen in other museums resemble in their ground-colour fig. ii.

The stripes on the head, neck, and body are darker except those of fig. iii. Edwards's Quagga is described as with black stripes.

Along the back in continuation of the mane a dark brown stripe, having a breadth of 3 cm. on the withers, expanding to 12 cm. on the crupper, and growing again narrower towards the tail, on which it extends to a length of 12 cm., terminating with a breadth of

In figure x. this band is only to be seen on the croup; the pectoral region of the spine appears to be quite light. Figure iii. shows no dorsal band. The young Quagga of the Cape Town Museum is said to be also without this band.

0·5 cm. only. This dorsal band is bordered on the pectoral region by longitudinal creamy spots, which become more confluent on the lumbar and sacral parts, forming at last continuous undulated lines which vary in breadth from 0·5 to 1·5 cm.

The lateral spots or lines are well marked in figures iv., vii., and viii. only. Edwards's figure (i.) has white along the sides of the spinal band with black spots on it.

A *ventral band*, beginning with a brownish shade on the fore breast, extends as a dark brown stripe to the umbilicus: its greatest width in the middle of the breast is about 8 cm., it narrows to 2 cm. on the belly.

This is said to be not present in the young specimen at Cape Town.

Fetlocks with blackish rings just above the hoofs. *Ears* creamy, brownish at the back in the base, dark clay-colour thence to the end, extreme tips white.

Back of the nose nearly uniform clay-colour, between the nostrils dark brown; lips whitish, chin and throat uniform chestnut.

These black rings are not to be seen in figures i., ii., iii., iv., and vi., besides being indistinct in others (x.), but they appear on the photograph (fig. xi.). White tips are not observable on fig. ix. The back of the nose is apparently dark in figures iv., vi., vii., viii.

The dark striping is as follows:—Eight narrow lines run from between the eyes down to the back of the nose and up to the beginning of the mane; from the middle of the front a ninth medial line runs to the back of the nose. From the eyebrows six stripes on each side pass to the top of the head. From the inner corner and lower lid of each eye three indistinct stripes pass towards the nose. On the cheeks upwards from the corner of the mouth are five streaks more or less curved. Next to them four others on each jaw, of which the first makes an angle towards the eye, turning then upwards to the base of ear; while the next two run more directly in this direction, and the fourth embraces the base of ear, ending behind it at the mane. The 2nd and 3rd of these stripes are divided on the left side, the 6th on this side corresponding to the 4th on the right side.

The dark stripes of the head appear very different in the various figures. In fig. i. they are few in number and very narrow, and the interspaces are broad.

On the *neck* there are eight transverse bands, their respective breadths being 2, 3·5, 4·5, 5·5, 5·5, 7, 5, and 3·5 on the right; 2·5, 3, 4·5, 6, 7·5, 9, 8, 4·5 on the left side. The first six of them keep more or less apart, while the seventh and eighth unite in front of the fore-neck. The light creamy interspaces on the neck are very narrow, 1 or 2 cm. only.

These eight bands and the following two, or the homologues of them, are to be recognized in most of the figures, but they are in general narrower and the interspaces are broader. Fig. iii. comes in this respect nearest to our Quagga, and also does the colour. The stripes on the head and neck in figs. iv. and ix. are much darker. Edwards's Quagga (fig. i.) shows unusually narrow black bands on the neck and broad interspaces, just the contrary to our Quagga.

From the withers there run first two stripes to the front of the breast, where they join; they are rather narrow above and grow wider beneath. Then a single stripe that might be called a "*shoulder-stripe*" also takes its origin from the withers, and, passing the shoulders, divides into two branches on the humeral region. Inside the angle thus formed are some irregular and less distinct short stripes, of which four or five are directed obliquely upwards and partly unite with three others directed downwards and backwards. On the body there are seven other distinct bands getting more obsolete at the lower bifurcated ends, and confluent at last with the buff ground-colour of the flanks. Of these the first three connected with the longitudinal dorsal band have a breadth of from 6·5 to 8 and from 9 to 10 cm., the interspaces between them being 1 and 1·5 cm. The fourth of these bands sends an oblique branch to the croup, and thus encloses a triangular area of which the dorsal stripe forms a side. Within this there is another broad longitudinal stripe anastomosing twice or three times with the oblique one and also with the dorsal stripe.

The bifurcation of the shoulder-stripe is well seen in most of the figures except in fig. iv.

These stripes are not represented in most of the figures.

The vertical body-stripes are different in every figure. On the whole they are narrower and more numerous, besides they do not extend to the haunches.

These oblique stripes are not to be seen in some of the figures (iii., iv., and x.), in others there are spots in their places (figs. i. and vii.)

The triangles on both sides form

The saddle is wanting in figs. i.

together a kind of saddle, as is the case in all striped horses of the *burchelli*-group. The fifth band takes an oblique direction throughout, running as well as the sixth over the haunches, both becoming gradually narrower at their upper ends, and not quite reaching the dorsal band.	to iv. It may be recognized on v. and vi. and on the photo (xi.), as also the bands on the quarters, but they are not seen in fig. x., which represents the same individual.
A seventh, somewhat narrower but still distinct, although twice interrupted, stripe takes a direction from the groin and goes over the haunches to the root of the tail without reaching it. Between the 6th and 7th stripe is an *indistinct* short band. Three or four other oblique and gradually fading stripes are observable on the back of the haunches.	This reminds one of *Equus burchelli.*

On comparing the stripes and bands of our Quagga with the pictures of the other Quaggas and with the various forms of the Zebras of the Burchell-group, there seems to me no question that the Quaggas belong to that group. I also have the impression that, in spite of the variability of the marking, the examination of sufficient material would result in ascertaining the existence of homologous stripes in the group above mentioned. From a further careful comparison of all the different figures, and especially of the original picture of Edwards, with the stuffed specimens, or at least with photos of them, we could perhaps obtain sufficient answers to the following questions:—

(1) Is the Vienna Quagga specifically the same as Edwards's Quagga?

(2) Can other so-called Quaggas (as, for instance, those of the British Museum and of the Tring Museum) be identified with Edwards's Quagga, notwithstanding the differences pointed out so exactly by Mr. Pocock? (Ann. Mag. Nat. Hist. ser. 6, xx. p. 37).

(3) Can the Vienna Quagga be identified with the Quaggas of London and Tring?

To these questions I would only reply provisionally that the differences between Edwards's picture and the Vienna, London, Tring, and other specimens are certainly more essential than the differences between the Vienna Quagga on one side and the London, Tring, and other Quaggas on the other. Edwards's Quagga, as already remarked, much resembles *Equus burchelli* in some respects—*e. g.*, in the *black* stripes, well defined on the head and extremely narrow on the neck, and in the tufted tail.

As to the Vienna specimen, it is possible that its characters

may be merely individual, for we find among skins of Zebras from the same locality some with pure black stripes and others with brownish stripes. Besides, the transverse stripes on the body of our Quagga show a tendency to bipartition, and the oblique stripes incline to break up into blotches. There likewise remains the possibility that our specimen has been rather increased in size by the art of the taxidermist. Considering, however, that so many local forms of *Equus burchelli* have been distinguished during the last few years, it is by no means impossible that the Vienna specimen might be ultimately separated subspecifically from other Quaggas.

Vienna, Nov. 20th, 1901.

4. On a further Collection of Mammals made by Mr. Th. H. Lyle in Siam. By J. Lewis Bonhote, M.A.

[Received November 19, 1901.]

The following paper gives an account of a further small consignment of Mammals sent home by Mr. Th. H. Lyle from Siam. Although small in point of numbers it contains several specimens of considerable interest, and foremost among these is a fine example of the Siamese Hare, which proves to belong to a species not hitherto described. A specimen of *Sciurus atrodorsalis*, in immature pelage, and two specimens of *Mustela flavigula* form a valuable addition to the National Collection, and help considerably to the more correct understanding of their respective groups.

1. Cynopterus sphinx (Vahl).

Vespertilio sphinx Vahl, Scrivter af Naturhistorie-Selskabet, 4te Band, 1ste Heft, p. 123 (1797); Bonh. P. Z. S. 1900, p. 191; id. loc. cit. p. 875.

Cynopterus marginatus (Geoffr.), Flower, P. Z. S. 1900, p. 341.

a. ♀. N. Chiengmai, 27th Feb., 1901.

2. Mustela flavigula Bodd.

Mustela flavigula Bodd. Elench. Anim. p. 88 (*ex* Penn.) (1785); Flower, P. Z. S. 1900, p. 333.

Mustela flavigula subsp. *typica* Bonh. Ann. & Mag. Nat. Hist. ser. 7, vol. vii. p. 344 (April 1901).

a, *b*. ♂. N. Chiengmai, 28th Feb., 1901.

These two individuals closely agree with the description in my paper quoted above, with the exception that the hind-quarters could hardly be styled "very dark brown"; this apparent discrepancy is, however, merely due to faded pelage, for of the two specimens one is lighter than the other.

I append the measurements taken in the flesh, as they are

slightly at variance with those taken from the dried skin in my former paper :—

	Head and body.	Tail without hairs.	Hind foot (s. u.).	Ear.
a	589 mm.	440 mm.	108 mm.	4 mm.
b	565 "	435 "	107 "	4 "

3. SCIURUS CASTANEOVENTRIS GORDONI Anders.

Sciurus gordoni Anders. P. Z. S. 1871, p. 140; id. Zool. Res. Yunnan, p. 240 (1879).

Sciurus castaneoventris gordoni Anders., Bonh. Ann. & Mag. Nat. Hist. ser. 7, vol. vii. p. 164 (Feb. 1901).

a. ♂. Doi Sritepe, Chiengmai, 27th March, 1901.

Dimensions in flesh. Head and body 218 mm.; tail 193; hind foot 47; ear 21.

This form has hitherto been recorded only from Upper Burma, but the present specimen agrees perfectly with examples from the type locality.

4. SCIURUS CANICEPS Gray.

Sciurus caniceps Gray (nec Temm.), Ann. & Mag. Nat. Hist. x. 1842, p. 263; Bonh. P. Z. S. 1901, p. 55; id. Ann. & Mag. Nat. Hist. ser. 7, vol. vii. p. 271 (March 1901).

a, b, c. ♂ ♀ ♀. Sawankalok, Siam, 27th Dec., 1900.

Two of these specimens are passing into the bright pelage, while the third has fully assumed it.

5. SCIURUS ATRODORSALIS Gray.

Sciurus atrodorsalis Gray, Ann. & Mag. Nat. Hist. x. 1842, p. 263; Bonh. P. Z. S. 1901, p. 55.

a. ♀ imm. Chiengmai, Siam, 5th April, 1901.

This specimen, which is about three-fourths grown, differs from the adult in its much greyer coloration, the annulations on each hair being of a very pale grey. The colouring of the ears, however, shows a faint yellowish tinge, and down the centre of the back there is a slight trace of the dark colour characteristic of the adult. The underparts resemble those of the adult.

6. MUS CONCOLOR Blyth.

Mus concolor Blyth, J. A. S. B. xxviii. p. 295 (1859); Bonh. P. Z. S. 1900, p. 195; Flower, loc. cit. p. 361.

a. ♂ ad. Chiengmai, Siam, 3rd April, 1901.
b. ♀ ad. Chiengmai, Siam, 21st April, 1901.

7. MUS JERDONI (Blyth).

Leggada jerdoni Blyth, J. A. S. B. xxxii. p. 350 (1863).

a. ♂ ad. Doi Sritepe, Chiengmai, 15th April, 1901.
b, c. ♀ ad. Doi Sritepe, Chiengmai, 16th & 17th April, 1901.

8. LEPUS SIAMENSIS, sp. n.

Lepus sp. inc. Flower, P. Z. S. 1900, p. 365; Bonh. P. Z. S. 1901, p. 56.

General colour above fulvous and dark brown, the latter colour becoming absent on the hind-quarters and flanks, where the fulvous is slightly tinged with rufous. The whole of the under-parts except the lower neck and chest pure white, the line of demarcation being sharply defined. The neck, chest, and limbs are fulvous of varying shades, the colour being deepest on the fore legs, where it is tinged with rufous, and palest on the inner sides of the hind limbs, where it becomes nearly white. Each hair is dull white or greyish at the base, shading into dark brown (seal-brown, Ridgw.[1]) and having a broad subterminal fulvous (buff, Ridgw.) annulation.

On the head the fulvous becomes deeper in colour, and there is an ill-defined whitish stripe running from the nostril to the front of the eye on either side.

The ears, which are but scantily clothed with hair on their outer posterior surface, resemble on the anterior surface the general colour of the back, although the darker tint predominates. The outer anterior and posterior margins are white. At the tip the inner surface is clothed with pure fulvous hairs, while on the external surface the hairs are dark brown.

The tail is dark brown above throughout its length and white underneath, with a slight tinge of buff on the sides.

The skull resembles most nearly that of *L. peguensis*, from which it differs chiefly in the muzzle being slightly broader at its base. The basioccipital bulges outwards and downwards on either side instead of having its sides parallel, thus causing the bullæ to appear at first sight somewhat smaller. The skull as a whole is, moreover, rather larger. Comparing the grooves on the upper incisors with those figured in Dr. Forsyth Major's paper (Trans. Linn. Soc., 2nd ser. Zool. vol. vii. p. 468, 1899), it appears to be most nearly allied to *L. hainanus*, although somewhat intermediate between it and *L. dayanus*. The groove in the species under consideration is moderately broad and nearly rectangular, with a small rounded process jutting out at about the centre of the outer margin.

Dimensions of type (in flesh). Head and body 435 mm.; tail 66; hind foot 95; ear 82.

Skull. Greatest length 86; breadth of palate at 1st molar 13; length 1st premolar to outer edge of incisors 27; greatest breadth of brain-case 30.

Hab. Siam.

Type. B.M. 1.7.7.13. ♂ ad. Chiengmai, 16th Feb., 1901.

This fine species is most nearly allied to *L. hainanus* Swinhoe, from which it is easily distinguished by its greater size and the

[1] Ridgway, 'Nomenclature of Colours,' Boston, 1886.

absence of a clearly defined white supra-orbital stripe. From *L. peguensis*, to which it more nearly approaches in size, it differs in the fur on the back and tail being dark brown instead of black, and in the absence both of the ashy tinge on the rump and the black terminal patch on the posterior outer surface of each ear.

The skull of a species of *Lepus* sent home by Mr. Lyle in a former collection agrees with the type skull. The animal to which it belonged was unfortunately destroyed, but Mr. Lyle writes that it was a female, and the following are the measurements in the flesh:—Head and body 463 mm.; tail 74; hind foot 97; ear 84.

For the sake of comparison the measurements of the skulls of *L. hainanus* (type), *L. peguensis*, and the two skulls of this species are appended:—

	Lepus siamensis (type).	*Lepus siamensis.*	*Lepus hainanus.*	*Lepus peguensis.*
	mm.	mm.	mm.	mm.
Greatest length	86	89	72	85
Breadth between 1st molars	13	13	11	13
Least breadth between orbits	13	12	12	13
Length from 1st premolar to outer edge of incisors.	26	27	21	25
Greatest breadth of brain-case	30	28	26	28
Height, crown to base of lower jaw	54	...	...	53
Greatest breadth of basioccipital	10	11	10	9
Posterior breadth of nasals	21	21	16	18

5. On the Insects of the Order Rhynchota collected by Sir Harry Johnston, K.C.B., in the Uganda Protectorate. By W. L. Distant.

[Received November 23, 1901.]

(Text-figure 8.)

The few specimens of this Order collected by Sir H. H. Johnston, and by him presented to the British Museum, are principally interesting as showing that the Uganda Rhynchotal fauna and that of West Africa are practically identical. The species known only from East Africa are very few, and further knowledge may prove them still fewer. Two new species are described, one of which has a far wider distribution than the Uganda Protectorate. I have added notes to the enumeration of each species as explanatory of its geographical dispersion.

HETEROPTERA.

Fam. PENTATOMIDÆ.

Subfam. SCUTELLERINÆ.

CRYPTACRUS COMES.

Tetyra comes Fabr. Syst. Rhyng. p. 130. 8 (1803).
Var. Dist. Ent. Monthl. Mag. xiv. p. 75 (1877).
Mt. Ruwenzori.

Resembling the variety I described from the Camaroons (*supra*), but with slight traces of an ochraceous subapical fascia to the scutellum. A highly variable and widely distributed species found all over tropical and subtropical Africa.

Subfam. DINIDORINÆ.

CYCLOPELTA TRISTIS.

Dinidor tristis Stål Hem. Afr. i. p. 212 (1864).
Mts. Ruwenzori and Entebbe.
A species hitherto known only from West Africa.

ASPONGOPUS LIVIDUS.

Aspongopus lividus Dist. Ann. Mag. Nat. Hist. (7) xi. p. 315 (1898).
Var. Abdomen above testaceous.
Mt. Ruwenzori.

In typical specimens described from Nyasaland the abdomen above is dark olivaceous. I can, however, discover no other differential characters.

ASPONGOPUS NIGRO-VIOLACEUS.

Pentatoma nigro-violacea Pal. Beauv. Ins. p. 83, Hem. pl. 7. fig. 4 (1805); Dist. Ent. Month. Mag. xv. p. 10 (1878).
Mt. Ruwenzori.
A species hitherto recorded only from West Africa.

Fam. COREIDÆ.

Subfam. MICTINÆ.

ANOPLOCNEMIS TRISTATOR.

Lygæus tristator Fabr. Syst. Rhyng. p. 206 (1803).
Mt. Ruwenzori.
A West-African species.

Fam. PYRRHOCORIDÆ.

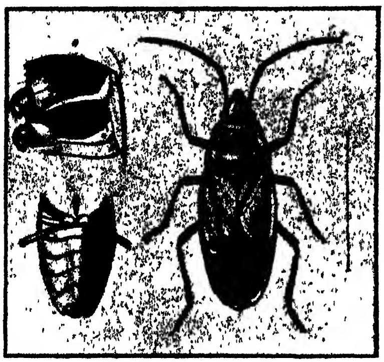
Subfam. PYRRHOCORINÆ.

ODONTOPUS NOTABILIS, sp. n.

Ochraceous; antennæ black; head, basal joint and base of

second joint of antennæ, and legs reddish ochraceous; scutellum, base of clavus, a round spot near apex of corium, discal area of prosternum, anterior areas of meso- and metasterna, a lateral basal spot behind eyes, two discal transverse lines to pronotum (one curved near anterior margin the other straight near centre), and abdominal segmental incisures (not extending to lateral margins and concolorous on disk), black.

Text-fig. 8.



Odontopus notabilis.

First joint of antennæ with a few distinct hairs near base and some hairs at apices of second and third joints, third joint shortest, second and fourth joints subequal in length; corium and clavus very thickly, finely, and obscurely punctate; the black base of clavus coarsely punctate.

Long. 16 to 22 mm.

Entebbe.—The British Museum also possesses specimens from East Central Africa (*G. F. Scott Elliot*); Kavala Island, Lake Tanganyika (*A. Carson*), and Angola.

Sericocoris johnstoni, sp. n.

Head, pronotum, scutellum, body beneath, and legs ochraceous: lateral margins of pronotum, the corium, and lateral margins of sternum pale purplish antennæ, central longitudinal fascia and basal margin to head, the margins of the anterior area of pronotum, basal margin of scutellum, rostrum, tibiæ, tarsi, and margins of sternal segments, black; membrane pale brownish. Pronotal margins somewhat strongly reflexed; corium and clavus thickly punctate.

Long. 14 mm.

Entebbe.

Fam. REDUVIIDÆ.

Subfam. ACANTHASPINÆ.

PLATYMERIS RHADAMANTHUS.

Platymeris rhadamanthus Gerst. in v. d. Deckens's Reise, iii. (2) p. 419, pl. xvii. fig. 8 (1873).

Baringo, 4000 ft.

A species known only from East Africa.

HOMOPTERA.

Fam. CICADIDÆ.

PLATYPLEURA RUTHERFORDI.

Platypleura rutherfordi Dist. Ann. Mag. Nat. Hist (5) xi. p. 173, pl. ii. fig. D (1883).

Entebbe.

A species originally described from West Africa, and since received from Mashonaland.

Fam. CERCOPIDÆ.

Subfam. APHROPHORINÆ.

PTYELUS FLAVESCENS.

Tettigonia flavescens Fabr. Ent. Syst. iv. p. 24. 30 (1794).

Entebbe.

A most variable species distributed over the greater part of tropical and subtropical Africa.

6. On two Collections of Lepidoptera made by Sir Harry Johnston, K.C.B., in the Uganda Protectorate during the year 1900. By ARTHUR G. BUTLER, Ph.D., F.L.S., F.Z.S., &c.; Senior Assistant-Keeper, Zoological Department, British Museum (Nat. Hist.).

[Received November 12, 1901.]

(Plate I.[1])

The two collections of which the following is a list were obtained at Entebbe, Port Alice, East Ugowe, Busiro; and from Ruwenzori, Toro, and the Congo forest, respectively. The first consignment consisted [illegible] well-known and widely distributed forms; but the second not only included a good sprinkling of rarities, of species new to the Museum Collection, and even of undescribed species, but was especially interesting from the strange commingling of Eastern and Western types which it contained.

[1] For explanation of the Plate, see p. 51.

Among the rare species, *Melinda mercedonia*, *Monotrichtis saussurei*, *Ypthima albida*, *Charaxes bipunctatus*, *Harma hobarti*, *Diestogyna amaranta*, *Neptis nicomedes*, *Acræa toruna*, *Acræa orinata*, *Acræa oreas*, *Terias punctinotata* ♂, *Belenois solilucis*, *Belenois raffrayi*, *Papilio lormieri*, and *Celænorrhinus opalinus* ♀ are worth special note. The new species are *Harma johnstoni*, *Pseudathyma plutonica*, and *Aphnæus hollandi*: there is also a new moth.

The following is a list of the species:—

1. *Amauris niavius* Linn. Toro, June 16th.
2. „ *enceladus* Brown. „ „
3. „ *albimaculatus* Butl. „ „
4. *Melinda mercedonia* Karsch. „ „
5. *Tirumala petiverana* Doubl. „ „
6. *Monotrichtis perspicua* Trim. Ruwenzori, 5000 ft., Sept.
7. „ *safitza* var. *campina* Auriv. Ruwenzori, 4200 ft., Sept.
8. „ *saussurei* Dewitz. Ruwenzori, 5000 ft., Sept.
9. *Ypthima granulosa* Butl. „ „ „
10. „ *albida* Butl. „ „ „
11. *Charaxes numenes* Hewits. Entebbe, April 30th.
12. „ *tiridates* Fabr. Toro, June.
13. „ *bipunctatus* Roths. „ „
14. *Precis boopis* Trim. Port Ugowe, 20th Feb. & 23rd July.
15. „ *clelia* Cram. „ 20th & 21st Feb.
16. „ *cebrene* Trim. „ 20th & 22nd Feb.
17. „ *westermanni* Westw. Toro, June.
18. „ *terea* Drury. Entebbe, April 20th.
19. „ *gregorii* Butl. Toro, June 16th.
20. „ *chorimene* Guér. Port Ugowe, April 21st & 22nd.
21. *Protogoniomorpha temora* Feld. Toro, June 16th.
22. *Hypolimnas salmacis* var. Drury. Congo forest, July 16th.
23. „ *misippus* Linn. Port Alice, 23rd March.
24. *Chloropœa lucretia* Cram. Toro, June.
25. *Harma johnstoni* Butl. Toro, June 16th.
26. „ *cœnis* Drury. Congo forest, July 4th.
27. „ *hobarti* Butl. Toro, June 16th.
28. „ *aramis* Hewits. Congo Forest, July 16th.
29. „ *theobene* Doubl. „ „
30. *Crenis occidentalium* Mab. Busiro, June 2nd; Toro, June 16th.
31. „ *boisduvalii* Wllgr. „ „ „ „
32. *Euphædra eleus* var., Drury. Congo forest, July.
33. „ *inanum* var., Butl. Toro, June; Congo forest, July 16th.
34. „ *xypetina* Stgr. Congo forest, July 16th.
35. „ *spatiosa* var., Mab. Toro, June.
36. *Aterica galene* Brown. Congo forest, July 16th.
37. *Cynandra opis* Drury. „ „
38. *Euryphene abesa* Hewits. „ „

39. *Diestogyna amaranta* Karsch. ♀, Toro, June 16th; ♂, Congo forest, July 16th.
40. ,, sp.? (♀ near *felicia*). Congo forest, July 16th.
41. *Pseudathyma plutonica* Butl. Toro, June.
42. *Kallima rumia* Westw. Toro, June 16th.
43. *Eurytela hyarba* Fabr. Busiro, 5050 ft., June 2nd.
44. *Ergolis enotrea* Cram. Toro, June 16th.
45. *Catuna crithea* Drury. ,, ,,
46. *Neptis nicomedes* Hewits. Busiro, 5500 ft., June 2nd.
47. ,, *melicerta* Drury. Congo forest, July 16th.
48. *Atella phalantha* Drury. Port Alice, March 20th; Entebbe, April 30th.
49. *Acræa toruna* ♀, Gr.-Sm. Toro, June 16th.
50. ,, *alicia* Sharpe. ,, ,,
51. ,, *uvui* Gr.-Sm. ,, ,,
52. ,, *vinidia* Hewits. ,, ,,
53. ,, *serena*, var. *rougetii* Guér. Port Ugowe, Feb. 20th.
54. ,, *encedon*, var. *lycia* Fabr. Entebbe, April 20th.
55. ,, *onerata* Trim. Port Ugowe, Feb. 20th & 22nd.
56. ,, *natalica*, var. *dissôciata* Gr.-Sm. Ruwenzori, 7000 ft., Sept.
57. ,, *zetes*, var. *menippe* Drury. Entebbe, March 20th & April 30th.
58. ,, *orinata* ♀ Oberth. Entebbe, April 30th.
59. ,, *oreas* Sharpe. Toro, June 16th.
60. *Megalopalpus zymna* Westw. Congo forest, July 16th.
61. *Zeltus*? *antifaunus* Hewits. ,, ,,
62. *Aphnæus hollandi* ♂ Butl. ,, ,,
63. *Cacyreus lingeus* Cram. Toro, June 16th.
64. *Azanus natalensis* Trim. ,, ,,
65. *Zizera antanossa* Mab. Port Ugowe, Feb. 22nd.
66. *Nychitona medusa*, var. *alcesta* Cram. Entebbe, April 30th.
,, ,, ,, *immaculata* Auriv. Toro, June 16th.
67. *Colias electo*, var. *edusa* Fabr. Toro, June.
68. *Terias brigitta*, var. *zoe* Hopff. Port Ugowe, Feb. 21st & 22nd.
69. ,, *boisduvaliana* Mab. ,, ,,
70. ,, *punctinotata* ♂ Butl. Toro, June.
71. *Catopsilia florella* Fabr. Port Ugowe, Feb. 21st & 23rd.
72. *Belenois solilucis* Butl. Toro, June 16th.
73. ,, *calypso* var., Drury. ,, ,,
74. ,, *instabilis* Butl. Port Ugowe, Feb. 20th; Toro, June 16th.
75. ,, *formosa* Butl. Toro, June 16th.
76. ,, *severina* var. *infida* Butl. Port Ugowe, Feb. 20th to 23rd.
77. ,, *mesentina* Cram. Port Ugowe, Feb. 20th to 23rd.
78. ,, *raffrayi* Oberth. Toro, July 16th.
79. *Pinacopteryx liliana* Gr.-Sm. Port Ugowe, Feb. 23rd.
80. *Leuceronia argia* ♀, var. *idotea* Boisd. Congo forest, July.
81. ,, *pharis* ♂, var., Boisd. Toro, June.

82. *Eronia dilatata* Butl. Port Ugowe, Feb. 23rd.
83. *Papilio policenes* Cram. Port Alice, March 20th.
84. " *demodocus* Esper. Entebbe, April 30th; Toro June 16th.
85. " *lormieri* Dist. Toro, June.
86. *Eretis perpaupera* Holl. Toro, June 16th.
87. *Celænorrhinus opalinus* ♀ Butl. " "
88. *Baoris inconspicua* Bertol. Entebbe, April 30th.

New Species, &c.

HARMA JOHNSTONI, sp. n. (Plate I. figs. 4, 5.)

Nearly related to *H. herminia* of Grose-Smith; larger, with almost the same pattern: the male paler and more olivaceous at base; the pale yellow belt of the secondaries much wider; the blackish macular belt across the disk of the wings rather wider on the primaries and with its inner edge on the secondaries acutely zigzag; the external area less ochreous; the irregular black submarginal line better defined and with long denticles pointing outwards on the folds between the nervures; the yellow lunate band between this line and the discal belt considerably narrowed and partly obscured by dark brown; the external border dark brown, only interrupted by pale yellow patches on the subcostal interspaces in the secondaries, but in the primaries interrupted by small patches excepting on the lower radial interspace: on the under surface the pattern is similar to that of *H. herminia*, but the colouring is less rosy, greyer, the enclosed irregular band limited externally by the straight central line is narrower and becomes uniform with the ground-colour below the subcostal vein. Expanse of wings 72 mm.

The female has the general pattern above of what I regard as *H. herminia* ♀ (an insect nearly related to *H. capella* ♀); the primaries are, however, much more produced at apex and the secondaries at anal angle; the basal area of the wings is much more broadly suffused with ferruginous along the veins, the central blackish band on the secondaries is almost obliterated, only clearly discernible towards the costa, but is followed by a series of indistinctly whitish-edged grey lunules followed by white dots, the submarginal irregular black line being indistinct excepting for the denticles on the folds between the veins: on the under surface, as in the supposed female of *H. herminia*, the pattern and general colouring nearly approach those of *H. lurida* ♀, but with less white on the primaries and with the central line much narrower and red-brown rather than brick-red. Expanse of wings 89 mm.

Toro, 16th June, 1900.

DIESTOGYNA AMARANTA Karsch. (Plate I. figs. 2, 3.)

♀. Dark olive-brown above, irrorated with pale ochreous and banded with the same colour; discoidal cell of primaries with

similar pale-bordered but indistinct markings; a discal increasing oblique belt slightly curved, with sinuated inner edge and diffused outer edge from subcostal to first median vein, from first median vein to inner margin abruptly narrowed and of equal width, slanting obliquely inwards; a chain-like double series of opposed lunules parallel to outer margin; outer border rather paler (because more densely irrorated with pale ochreous) than the rest of the wing: secondaries crossed from just before middle by four pale ochreous bands, the first slightly irregular and sharply defined internally, diffused externally, continuing the discal belt of the primaries; the second and third continuing the chain-like series of the primaries, the fourth submarginal, less defined than the others, undulated; outer border as in primaries. Wings below altogether paler than in the male, greyer, the discal belt of upper surface well defined, but pinky whitish on the secondaries; the basal area of these wings irrorated with pearl-grey indicating two vague subbasal bands; the chain-like belt pearl-grey on both wings and with white points on the upper internal lunules of the primaries and the lower internal lunules of the secondaries. Expanse of wings 56 mm.

Toro, June 16th.

Prof. Aurivillius has pointed out that the female figured by Karsch does not belong to this species and has named it *D. karschi.*

A second female similarly coloured is in the collection; but, without the male, it would be rash to name it: in pattern it is not unlike *D. felicia*, but it is a much shorter-winged insect.

PSEUDATHYMA PLUTONICA, sp. n. (Plate I. fig. 6.)

Allied to *P. sibyllina*, but smaller, shorter in wing, the primaries with much less sinuous outer margin, the secondaries rounded, not produced at anal angle; the discal belt of the primaries forming three patches, the first three divisions being much shorter than in *P. sibyllina*; the belt of the secondaries constricted towards costa and not deeply indented externally; the inner submarginal line only white in the centre: on the under surface the markings on the basal area, excepting a costal patch on the secondaries, suffused. Expanse of wings 42 mm.

Toro, in June.

ACRÆA ORINATA Oberthür. (Plate I. fig. 1.)

♀. This is the largest female of the group yet described, and much more nearly resembles the male of *A. parrhasia* than anything else: the primaries show a pinky-white, semitransparent, oblique, trifid bar beyond the cell in continuation of the discal tawny belt, and the basal area of the secondaries is almost wholly black: on the under surface this sex chiefly differs from *A. orinata* ♂ in showing a diffused whitish patch beyond the cell of primaries. Expanse of wings 70 mm.

Entebbe, April 30th.

I once supposed that *A. orinata* would prove to be a variety of *A. oppidia* ♂, and Prof. Aurivillius believed it to be a form of *A. orina*, but we were both wrong; it is a good distinct species.

Aphnæus hollandi, sp. n. (Plate I. fig. 7.)

♂. Nearly allied to *A. orcas*; but the metallic colouring of the upper surface more brilliant and rather emerald-green than greenish blue; the black cell-spots on the primaries are considerably larger and the apical area is black with scarcely a trace of metallic scaling, the subapical series of spots (of which only the two uppermost are clearly visible) reduced to a few metallic scales; on the secondaries the metallic patch extends closer to the outer margin, the apical area is browner, and the marginal spot between the tails is ochreous instead of red: on the under surface the differences are much more marked; the ground-colour of the primaries is of a palish earthy brown with the silver markings bordered with deep maroon; the arrangement similar to that in *A. orcas*, but the short band at end of cell truncated in front and gradually narrowing backwards; no submarginal silver spots; the oblique streak towards external angle very narrow; secondaries with the ground-colour yellowish stone-colour suffused with grey (or sordid) towards base and apex; the silver markings bordered with ferruginous red; the arrangement of these markings is similar to that in *A. orcas*, but the submarginal series is placed upon a ferruginous band and is almost obliterated excepting at anal angle; the oblique internal bar above the latter is curved, so as almost to join the broad discal belt, and the two silver spots above it are greatly reduced in size; the anal lobe is much paler in colouring—ochreous with a quadrate central ferruginous patch; the fringe brown where it is black in *A. orcas*. Expanse of wings 39 mm.

Congo forest, July 16th, 1900.

I have named this beautiful little butterfly in honour of my friend Dr. W. J. Holland of Pittsburg, whose admirable photographic plate in the 'Entomological News' for 1893 has greatly facilitated the identification of the species of *Aphnæus*.

Belenois calypso Drury.

Var. ♂. The secondaries white below, with the usual markings, but the orange streaks at base and apex of costa (which are usually ill-defined) and a dash at the base of the submedian vein sharply defined in deep orange (more so than in *B. dentigera*).

Prof. Aurivillius correctly states that *B. agylla* is synonymous with *B. solilucis* (not with *B. ianthe*). Until I saw the specimens in the present collection, I was not aware that the border of the primaries was ever so wide in *B. solilucis* as is shown in Rogenhofer's figure, and I naturally supposed the regularity of the border in that figure to be due to inaccurate drawing.

BELENOIS FORMOSA Butl.

The intermediate phase of this species from Toro differs from the wet phase in the smaller and partly obliterated white spots in the apical border of the primaries; and on the under surface in the pale earthy-brown subapical streak and veins on the primaries and the brown veins and markings on the secondaries. The dry phase (which we obtained from the Crowley collection) is still less spotted on the apical area of the primaries above, has the apical area of these wings below and the secondaries of a whity-brownish tint with still paler brown markings than the intermediate phase.

♂, Toro (*Sir H. Johnston*); ♂ ♂, Mt. Elgon (*F. J. Jackson*).

Among the Lepidoptera Heterocera there was nothing of interest with the exception of a very remarkable new genus of *Sesiidæ*, which Sir George Hampson has asked me to describe.

CRYPTOMIMA, gen. nov.

Allied to *Ceratocorema*. Wings for the greater part opaque, brilliantly metallic: primaries narrow, elongated, the costa nearly straight to $\frac{3}{4}$, then gradually deflexed to apex, which is moderately acute; outer margin very oblique, slightly convex, passing gradually into inner margin, which is slightly concave almost to the base: secondaries with the costal margin nearly straight to apex, the apex moderately defined, the outer margin slightly arched to first median branch and thence nearly straight to anal angle; abdominal margin sinuous, widest in the centre. The neuration may be characterized by veins 7 & 8 of the primaries being emitted from a long footstalk; vein 4 of the secondaries absent. Body smooth and shining; the antennæ simple; palpi rather slender, elongated, second joint upturned, slightly curved, third joint porrected at an oblique angle, spine-like. Front legs with tibiæ coarsely fringed below; second pair fringed externally, the upper end of the joints with the fringe projecting, two well-developed unequal spurs; third pair smooth, with two long unequal spurs beyond the middle and two below the end of the tibiæ, the latter joints and the tarsi coarsely setose: abdomen with a long densely scaled process with naked extremity from the dorsal surface of the terminal joint, resembling the ovipositor in certain *Ichneumonidæ*; vulva tufted.

CRYPTOMIMA HAMPSONI, sp. n. (Plate I. fig. 8.)

Wings above steel-blue glossed with green, brilliantly metallic: primaries with a small bifid subbasal patch divided by the median vein; end of cell and median vein blackish blue; beyond the cell a hyaline belt brilliantly shot with golden-green from near costa to near external angle, slightly increasing in width from front to back of wing: secondaries with the basal two-sevenths hyaline crossed by steel-glossed black veins. Body above steel-black,

slightly purplish; eyes red-brown; face opaline whity brown; palpi whity brown, second joint with opaline white scales; pectus and legs steel-blue; terminal joints of hind tarsi whitish below; venter nacreous, the base broadly whitish followed by a still broader dull steel-blue band, beyond this a second whitish band or patch and then a second steel-blue band; anal fringes ochraceous and smoky black. Expanse of wings 35 mm.

Toro, June 16th, 1900.

I have named this remarkable insect in honour of my colleague, Sir George Hampson, Bart., who is engaged upon a complete Catalogue and Revision of the African Lepidoptera Heterocera.

EXPLANATION OF PLATE I.

Fig. 1. *Acræa orinata* ♀, p. 48.
2. *Diestogyna amaranta* ♂, p. 47.
3. " " ♀, p. 47.
4. *Harma johnstoni* ♂, p. 47.
5. " " ♀, p. 47.
6. *Pseudathyma plutonica* ♂, p. 48.
7. *Aphnæus hollandi* ♂, p. 49.
8. *Cryptomima hampsoni* ♀, p. 50.

February 4, 1902.

Prof. G. B. Howes, LL.D., F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of January 1902:—

The registered additions to the Society's Menagerie during the month of January were 87 in number. Of these 32 were acquired by presentation and 3 by purchase, 47 were received on deposit, 4 were born in the Menagerie, and 1 was received in exchange. The total number of departures during the same period, by death and removals, was 168.

Amongst the additions attention may be specially directed to:—

1. A female White-tailed Gnu (*Connochætes gnu*), born in the Menagerie on January 10th, from one of the females presented by Mr. C. D. Rudd, F.Z.S., in August 1901.

2. Nine Pheasant-tailed Jacanas (*Hydrophasianus chirurgus*) from India, presented by Mr. Frank Finn, F.Z.S., on January 11th.

This peculiar bird is new to our collection, and we are greatly obliged to Mr. Finn for sending us the specimens, as also to Mr. Knifton, of the P. & O. s.s. 'Malta,' under whose care they were placed during the voyage home.

3. Three Red River-Hogs (*Potamochœrus penicillatus*), born in the Menagerie on January 27th.

The breeding of the Red River-Hog in captivity is a noticeable

event, but it has already occurred on two previous occasions in the Society's Menagerie (*cf.* P. Z. S. 1861, p. 62, pl. xii.).

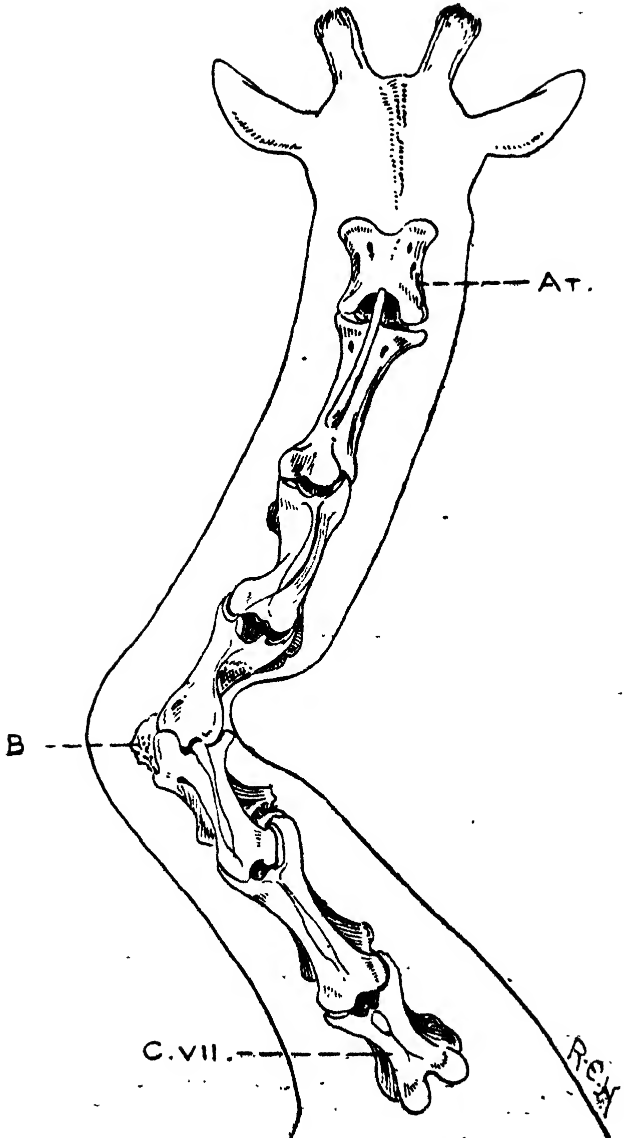
Mr. F. E. Beddard, F.R.S., laid before the Meeting the neck-vertebræ of a young male Giraffe (*Camelopardalis giraffa*) which had died in the Society's Gardens on Jan. 8th, and made the following remarks:—

It will be remembered that this animal in life showed a permanent bend in the neck, which was slight and hardly noticeable at the time of its arrival, but increased greatly before the time of its death. After death the neck-vertebræ were carefully cleaned and have revealed the causes of this bend, which undoubtedly pressed upon the spinal cord. There was no tumour of any kind, bony or otherwise, the existence of which might possibly have been presupposed from the external appearance of the neck. The bend in the neck was in fact related to the following condition of the cervical vertebræ.

The vertebræ chiefly affected—but, as will be seen presently, not the only ones affected—are the fourth and fifth. These two vertebræ are in the first place firmly ankylosed together so as to be perfectly immovable the one upon the other. The bend occurs in this region, and is produced by these two vertebræ which lie in relation to each other at an angle of nearly 90°. This bend is due to an overgrowth on one side of these vertebræ, the left, and a cessation of growth on the other side. This overgrowth mainly concerns, so far as I can make out, the epiphyses of the vertebræ in question. The general appearance produced is that both vertebræ are shorter in relation to the adjacent vertebræ than the normal. I have observed that the fourth and fifth vertebræ are the two which have been mainly affected. Of these the fourth is more altered than the fifth. The neural spine of the fourth vertebra is curved towards the left in relation to the curvature of the whole vertebra; that is to say, the convex border of the curve is on the left side. In addition to this the spine itself is bent over to the opposite side, *i. e.* to the right, and forms a cavity deep enough to hide the first finger. Such a bending of the vertebral spine does not occur in the case of the fifth vertebra.

It is interesting to notice that the adjacent vertebræ have made an attempt, so to speak, to rectify the curvature caused by the injury to the fourth and fifth vertebræ. This state of affairs is naturally seen in the most marked degree in the two vertebræ immediately adjacent to those which have been injured. Particularly is this the case with the third vertebra. This vertebra is bent, but in the opposite direction to the fourth; it is the left side which is concave. The spine too is curved in the same direction, and there is a slight concavity formed in the same way by a bending over of the spine. This, however, lies on the left side and not on the right as is the case with the fourth vertebra. Even the axis vertebra is slightly asymmetrical, and a

Text-fig. 9.



Cervical vertebræ of a Giraffe.

Neck, showing cervical vertebræ *in situ*; dorsal aspect.

AT., atlas; B, overgrowth of fifth vertebra; C. VII., seventh cervical vertebra.

careful examination of the posterior half of the atlas shows that it is not perfectly symmetrical. The sixth vertebra is distinctly asymmetrical, but the seventh has retained its normal symmetry.

The drawing exhibited (text-fig. 9, p. 53) illustrates the facts that have been dealt with.

Dr. Chalmers Mitchell, F.Z.S., read, on behalf of Mr. E. Degen, a paper entitled "Ecdysis, as Morphological Evidence of the original Tetradactyle Feathering of the Bird's Fore-limb, based specially on the Perennial Moult of *Gymnorhina tibicen.*" The material on which the paper was based consisted of a large series of specimens of the *Gymnorhina* obtained at regular intervals throughout the moulting-period, and the author had thus been able to give a very complete account of the perennial replacement of the feathers, avoiding the errors due to observations on the altered habits as produced by captivity. The author showed that the moulting of the wing-feathers took place in definite groups, and indicated a composite origin of the modern feathering. He thought that the new facts brought forward strengthened his already published theory of the wing-feathers being derived from the feathers of a four-fingered manus. Incidentally he suggested that the eutaxy of the Passeres was essentially different from that of such primitive birds as the Gallinæ.

This Memoir will be published in full in the Society's 'Transactions.'

The following papers were read:—

1. Notes on the Osteology of the Short-nosed Sperm-Whale. By W. BLAXLAND BENHAM, D.Sc., M.A., F.Z.S., Professor of Biology in the University of Otago, New Zealand.

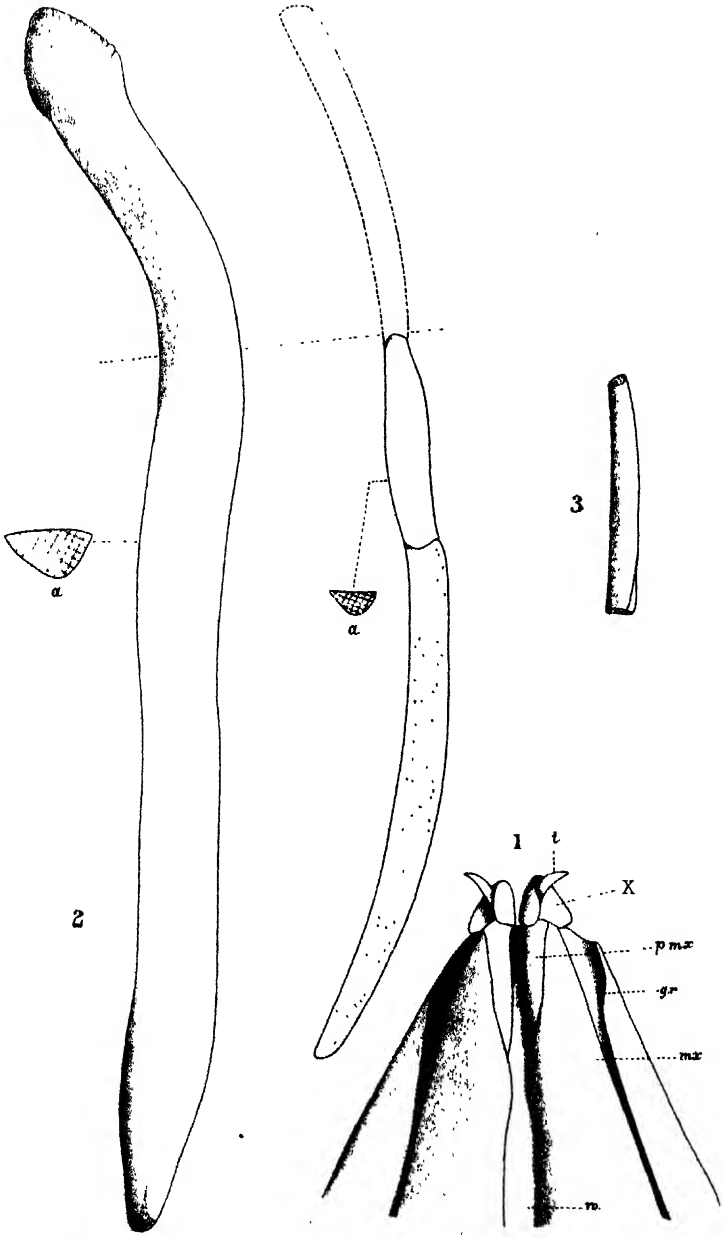
[Received November 8, 1901.]

(Plates II.–IV.[1])

A specimen of the Short-nosed Sperm-Whale (*Cogia breviceps*) came into my possession in 1900, and I have already communicated to the Society some remarks on certain of the viscera[2]. I now wish to offer some notes on the skeleton.

The animal, a male measuring 8 ft. 9 inches, had been cast ashore on the sandy beach at Parakanui, Otago; and though it had been a good deal cut about, I was able to obtain the entire skeleton, together with the cartilaginous portions of such structures as the hyoid, sternum, and limbs: these were put through the gelatino-glycerine process without any previous separation from the bones,

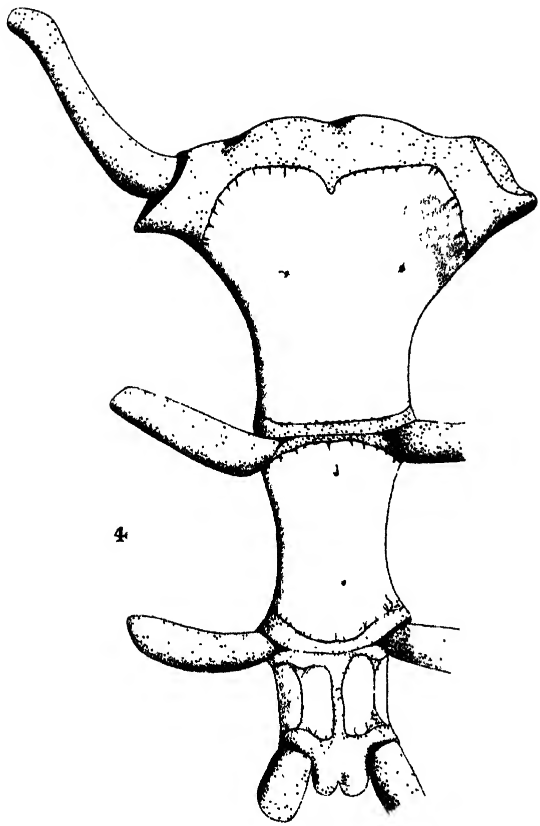
[1] For explanation of the Plates, see p. 62.
[2] See P. Z. S. 1901, vol. ii. p. 107.



M.P. Parker lith.

Parker & West imp.

OSTEOLOGY OF COGIA.



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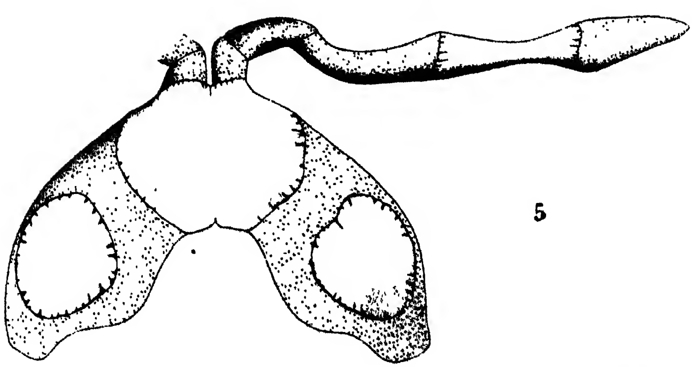

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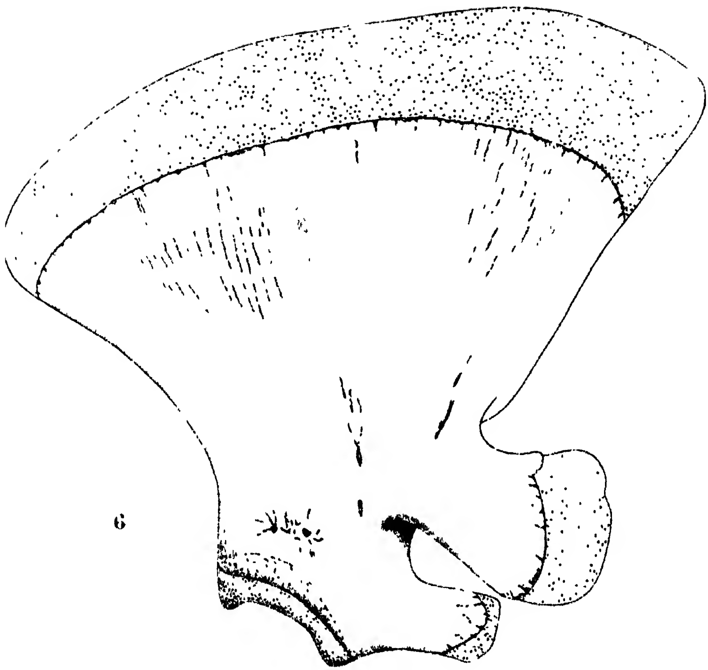
M P. Parker lith

Parker & West imp

OSTEOLOGY OF COGIA.



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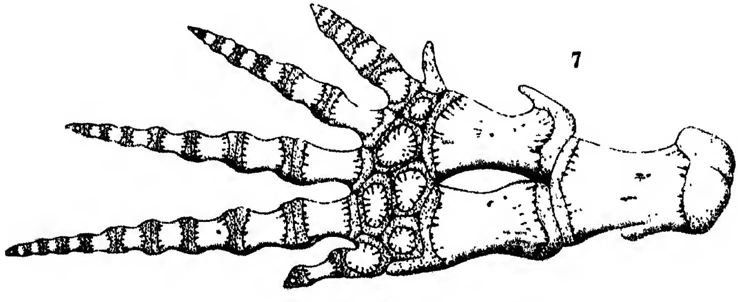

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M.P. Parker lith.

Parker & West imp

OSTEOLOGY OF COGIA.

and are thus preserved in a natural condition. There is one bone upon which some doubt must still be expressed, viz. the pelvis. Wall (**1**) describes and figures this structure as consisting of two pairs of more or less circular or oval plate-like bones, which he arranges in a transverse row—an inner smaller and an outer larger bone on each side; the bones are very unlike the pelvic bones of other Odontocetes, and as they were found in the sand, it is within the bounds of possibility that the identification is incorrect.

I searched the Parakanui carcase carefully for the pelvis: I removed the penis and found no bone in connection with it, and I feel quite certain that no bone existed, for the maceration was most carefully carried out, and the contents of the macerating-tube were sifted, so that even the cartilaginous epiphyses of the larger ribs were recovered; if there had been bones of the size and shape described by Wall, they could not have been overlooked.

The Axial Skeleton.

The total length of the dried skeleton, when the bones were laid out, in contact, is 2·39 metres (*i. e.* 7 ft. 11½ inches), of which the skull measures 0·39 m. (15½ inches) and the vertebral column 2·00 m. (6 ft. 8 inches). These measurements do not allow for the intervertebral discs. I have not deemed it necessary to give an account of the skull, as it has been adequately described and figured by Owen (**2**), and more recently by Beneden & Gervais (**5**). There is, however, one point to which I will refer, as it seems to have escaped the notice of previous authors.

At the tip of each premaxilla is a short triangular calcification—apparently not bone, but calcified cartilage, for it differs considerably from bone, both in colour and texture (Pl. II. fig. 1, *X*). Each of these "sclerites," or premaxillary nodules as they may be termed, is grooved along its lower surface, and in this groove lay the base of the single tooth of the upper jaw. This groove is in line with that on the maxillary bone, which is continued backwards as a canal, to join the infra-orbital canal.

The premaxillary nodule is not indicated in Owen's figure, in which the upper tooth is placed in the anterior end of the maxillary groove, and not on the premaxilla at all.

I have not seen the figure given in Van Beneden & Gervais's work, but no mention of the nodule occurs in the text: indeed, these authors express some doubt as to the existence of the upper teeth (p. 349). In a second skull in the Dunedin Museum, belonging to an older specimen, obtained from Napier, in the North Island, this premaxillary nodule does not exist; nor is there any sign that it has fused with the premaxillary bone, for the form of the latter and its relations to the maxilla are precisely the same as in the Parakanui skull, if the nodule be removed. No doubt this nodule remains separable from the bone, and hence the absence of the upper teeth in most of the skulls of *Cogia*.

In the lower jaw of my specimen there are 13 teeth on each side; but in the Napier skull I find 15. The former is the number given by Wall and Krefft (3); the latter number is attributed to this whale by de Blainville and by Van Beneden & Gervais; while Flower & Lydekker, in their text-book on the Mammalia (first edition), give the number as from "9 to 12."

The Vertebral Column.

Turning to the vertebral column, there are, in addition to the cervical mass of seven fused vertebræ, in which all trace of the separate vertebræ is absent, except of the 1st, 2nd, and 7th, 46 free vertebræ, of which 13 are thoracic, 9 are lumbar, 23 are caudal, of which the anterior 13 bear chevron-bones. In this enumeration I have followed Flower (on *Physeter*) in regarding as the first caudal that vertebra which carries at its hinder end the first chevron.

It may be useful to give a summary of the formula of the free vertebræ according to previous authors [1].

	Total No. of free Vertebræ.	Thoracic.	Lumbar.	Caudal.	Chevrons.
Wall	44	14	9	21	13
Von Haast...	43	12	11	20	8
Krefft.........	48	13	9	26	10
v. Beneden & Gervais	?	13	8	?	?

With regard to the number of thoracic vertebræ, there thus appears from the accounts to be some slight discrepancy. Von Haast has already pointed out that the total number of vertebræ "52," given by Wall, is due to an error in addition of the constituent vertebræ. Van Beneden & Gervais state (p. 351) that "whereas Wall describes 14 thoracic vertebræ and 14 pairs of ribs [2], we only count 13 on our figure." They suggest that perhaps the small 14th rib, being free and independent of the vertebral column, had disappeared during the preparation of the skeleton (*C. macleayi*), and they found only 13 thoracics in the Japanese specimens described on p. 515.

In the Parakanui skeleton there are only 12 pairs of complete ribs articulated with the vertebræ; but amongst the debris of the macerating-pan I found a small bone (Pl. II. figs. 2, 3), measuring only 37 mm. in length by 9·5 mm. in greatest breadth.

[1] Flower & Lydekker give C. 7; Th. 13 or 14; L.+C. 30: total 50 or 51.
[2] Wall found only the ribs of the right side.

The two ends are rough and evidently had cartilaginous continuations. One end is broader than the other, and is apparently the lower extremity: one surface is flat, and this I take to be the external surface; the other is very convex from side to side (see Pl. II. fig. 2, *a*), meeting the flat surface in a more or less sharp edge; one edge, the anterior, being much sharper than the other.

The general form of this little bone agrees very closely with the shape of that region of the 12th rib just distal of the curvature; here the outer surface is flat and the inner surface convex, the outline of a transverse section being (as shown in Pl. II. fig. 2, *a*) similar to that of the above small bone.

Further, I discovered a narrow, curved cartilage, four inches (100 mm.) in length, pointed at one end, truncated and slightly excavated at the broader end, which fitted on to the broad end of the small bone. There is no doubt in my mind but that this bone and cartilage constitute part, and the greater part, of the 13th rib of the left side; the upper end of which must have been connected to the 13th thoracic vertebra: the connection was probably by means of cartilage, for this narrower upper end of the bone is rough and convex.

On re-examining this vertebra, I noticed that the end of the transverse process is similar to that of the 12th, and unlike that of the succeeding vertebra, in that it has a small articular surface on the left side, but none on the right side.

We have here, I think, an explanation of the discrepancy as to the number of thoracic vertebræ; for, except in a very carefully macerated skeleton, this little bone would undoubtedly be overlooked; and in skeletons lying on the shore there is little likelihood of this last rib being found. Wall's figure, however, is erroneous in that he places the last rib (the 14th according to his enumeration) in line with the *lower* end of the preceding; but from the form of the bone and its resemblance to that part of the preceding rib, I think that it lay higher up, in the position indicated in Pl. II. fig. 2, with a long strip of cartilage below, and a shorter cartilage (which I did not succeed in recovering) above.

In Wall's specimen this last small rib measured 1½ inches, and the preceding rib 11½ inches. Krefft, too, notes that the last rib, the 13th, is but 4 inches in length, whilst the preceding is 12 inches. It is not stated whether the measurement of the rib was taken along the curve, or in a straight line from the capitulum to the free end, but presumably it was in the former manner.

In my specimen the 12th rib is 9·6 inches (235 mm.) along the outer curve, or in a straight line 8½ inches (215 mm.), and the bony part of the 13th rib is 1½ inches (37 mm.). I estimate that the total length of this rib, with both upper and lower cartilages, was about 8 inches (200 mm.).

We may then conclude that in *Cogia* there are 13 thoracic vertebræ, with 12 pairs of complete ribs articulating with the

column, and that the last (13th) rib is imperfectly ossified and that the bone does not reach up to its vertebra, except possibly in very old individuals.

The Sternum.

As far as I have been able to discover, the sternum of this whale has not yet received an adequate description. It was only partially recovered by Wall, who gives but a short account of the imperfect bone, while it is not referred to either by von Haast (4) nor by Van Beneden & Gervais.

In the Parakanui specimen the sternum (Pl. III. fig. 4) consists of three sternebræ; the first and second formed of a single bone apiece, the last of a pair of small bones. Each sternebra is capped by cartilage at each end, and the posterior end is bifid.

The anterior end of the sternum is bent slightly upwards, but otherwise the bones are flat; the thickness increases from the anterior end, where it is 8 mm., to the hinder end, which is 13 mm. in depth. The first two sternebræ have rounded lateral margins, while this margin, in the case of last pair of bones, is an abrupt slope downwards and outwards from the dorsal surface, with a sharp but obtuse upper and a sharper acute lower edge—the ventral surface of this last sternebra being wider than the dorsal surface.

There are four cartilaginous sternal ribs, measuring 90, 75, 60, and 30 mm. respectively.

The following measurements were made:—

	millim.
Total length, including cartilage	260
Greatest breadth	155
Least breadth	45
Length of the first bony sternebra[1] along the lower surface	90
Greatest breadth	100
Breadth at posterior end	60
Thickness (dorso-ventrally) in middle	10
Length of second bony sternebra	76
Breadth at anterior end	54
,, in middle	43
,, at posterior end	51
Thickness	12
Length of each ossicle of the 3rd sternebra	31
Greatest breadth	20
Thickness	13

The Hyoid.

The hyoid is very briefly referred to by Wall, and rather more fully described (with a figure) by Van Beneden & Gervais.

[1] Since the cartilages are only exceptionally preserved, the measurements of the bones are also given.

In the present specimen (see Pl. III. fig. 5) the bones and cartilage were uninjured.

The basihyal is a flat, irregularly circular bone, notched in the middle line posteriorly, and with a pair of slight prominences at the anterior end, separated only by a shallow furrow; each of these prominences bears a small tetrahedral cartilage, which evidently correspond to the bony projections seen in *Physeter*, but which in *Cogia* do not appear to ossify, for they are unrepresented in V. Beneden's figure.

The anterior cornu consists of two segments, viz.: a short proximal, curved cartilage, circular in section, representing the ceratohyal; and a much longer distal region, the middle of which ossifies to form the cylindrical stylohyal bone. The posterior cornu, as in *Physeter*, is a broad plate of cartilage, in the midst of which is a more or less circular flat bone—the thyrohyal bone. This posterior cornu is not segmented from the basihyal, the cartilage being perfectly continuous.

Measurements.

	millim.
Basihyal bone:	
Greatest breadth	84
,, length	66
Thickness	5
Length of cartilaginous process	18
Total length of each half of the basihyal + thyrohyal, from the anterior end of the cartilaginous process to tip of cornu	156
Greatest breadth, across the two posterior cornua, measured from the outer margins	188
Length of thyrohyal bone	55
Breadth of ,, ,,	46
Anterior cornu: total length	220
Length of ceratohyal cartilage (in middle line)	37
,, stylohyal segment	175
,, ,, bone (along its middle)	65
,, ,, hinder margin	75
Thickness	15

The Scapula.

This bone has been figured more or less accurately by all the authors who have dealt with this whale, but without the cartilages. The scapula has the usual cetacean form (see Pl. IV. fig. 6); its external surface is feebly concave, owing to the reversion of the anterior margin and of the superior border. The spine is but feebly developed, but the acromion is a large subquadrangular process. The coracoid process is large and well marked, not quite so long as the acromion. The glenoid cup is oval.

The following measurements of the bone, without its cartilage, were made:—

	millim.
Greatest height (from the highest point of the superior border to the anterior margin of the glenoid)	164
Length of the posterior border	107
" " anterior "	159
Greatest breadth (in a straight line from anterior to posterior angle of the superior border)	184
Breadth immediately above acromion	83
Length of glenoid cup	46
Breadth " "	31
Distance from the antero-superior angle to origin of acromion	76
Length of acromion	48
Vertical height (near root) of acromion	35
Distance from posterior margin of glenoid to tip of acromion	101
Length of coracoid (from anterior margin of glenoid)	47
Distance from posterior margin of glenoid to end of coracoid	84
Height of coracoid (at root)	22

The Pectoral Limb.

The limb has been more or less imperfectly figured by the various authors--a photograph of the "restored" limb having been added to the second edition of Wall's memoir, to replace an inaccuracy in the figure of the entire skeleton.

In this photograph, the restored carpals (which were gathered from the sand and pieced together) are fairly accurately placed; but the cartilages, having been represented by some artificial filling, do not show their characteristic independence. Wall describes "seven" carpals, but it is evident from later researches that the "two linear transverse bones" are merely the distal epiphyses of the radius and ulna, at the ends of which he locates them; the remaining 5 are accurately described in the text. The photograph is a truer representation of the hand than the woodcut accompanying Krefft's paper.

The figure given by Van Beneden & Gervais is also incomplete. It seems therefore worth while to present a complete figure of the entire limb (Pl. IV. fig. 7) showing all the cartilages and bones in their true position.

The humerus is provided with a small deltoid ridge, 15 mm. in length and 5 mm. in height. The head and tubercle, as well as the distal epiphysis, are embedded in cartilage, but are firmly united to the shaft of the bone. But the epiphyses of the radius and ulna are not as yet united, though they can be felt at each end by a needle thrust into the cartilage.

The proximal epiphysial cartilage of the ulna is prolonged downwards as a spur, which represents the bony olecranon of *Physeter*. This cartilage is indicated in the figure given by Krefft, and in the photograph of Wall's specimen, as a small bony process. In my specimen there is no ossification in this cartilaginous olecranon.

The distal epiphysial cartilage of the radius is produced along the outer sides of the carpus up to the metacarpal of the first digit, so as almost to suggest a carpal; but as each of the true carpals has its own cartilage around it, this prolongation seems to have some other significance.

The carpal bones are five in number, three belonging to the proximal row, and two to the distal series. Each is an irregular polygonal, more or less hexagonal, disc of bone embedded in its own cartilage. Each bone has vertical sides, without the "shelf" and without the epiphysis which exist in *Physeter*, to which, otherwise, they bear considerable resemblance. The pisiform is entirely cartilaginous. In the digits, each phalanx is provided with its own independent cartilaginous epiphysis at each end, as in Odontocetes generally. The metacarpals are short, not much longer than the proximal phalanx in each digit. That of the first digit is, as in *Physeter*, rounded and somewhat like a carpal; but Flower has given reasons for regarding this as a metacarpal, and the fifth metacarpal is also rounded. The relative lengths of the digits, in ascending order, are I., V., IV., III., II.

The number of phalanges is accurately shown in the drawing; whereas in the previously published figures some of the terminal, very small phalanges are missing.

The first	digit	possesses	two	phalanges;
,, second	,,	,,	ten	,,
,, third	,,	,,	seven	,,
,, fourth	,,	,,	six	,,
,, fifth	,,	,,	three	,,

These numbers refer to the right limb; on the left the second digit has only nine and the fifth only two phalanges.

It will be noted that the two to four terminal phalanges of the longer digits are more or less circular, as are all three of the fifth digit.

Measurements.

	millim.
Total length	372
Humerus:—Length (incl. cartilage)	95
,, ,, shaft only	65
Transverse diameter of shaft at upper end	45
,, ,, ,, lower end	50
Girth, in its middle	101
Thickness	24
Radius:—Length along preaxial border	75
,, ,, postaxial border	60
,, of bone only (in middle line)	60
Least breadth	30
,, thickness	12
Ulna:—Total length along postaxial border	63
,, ,, ,, preaxial border	60
,, ,, of bone (middle)	55
Least breadth	26
,, thickness	10

		millim.
Olecranon, length		25
Total breadth of carpus		80
Digits: Total length, including cartilage:—		
Left hand:	I. digit	52
„	II. „	185
„	III. „	158
„	IV. „	114
„	V. „	52
Right hand[1]:	I. „	55
„	II. „	183
„	III. „	148
„	IV. „	102
„	V. „	68

List of the memoirs to which references are made.

1. Wall: "History and Description of the Skeleton of a New Sperm-Whale." Sydney, 1851 (reprinted 1887).
2. Owen: "On some Indian Cetacea." Trans. Zool. Soc. vi. 1865, p. 30.
3. Krefft: "Notice of a New Species of Sperm-Whale." Proc. Zool. Soc. 1865, p. 708.
4. v. Haast: "On the Occurrence of a New Species of *Euphysetes* on the Coast of New Zealand." Tr. N. Z. Institute, vi. 1873, p. 97.
5. Van Beneden & Gervais: 'Ostéographie des Cétacés,' pp. 349, 515, pl. 61 (1880).

EXPLANATION OF THE PLATES.

Plate II.

Fig. 1. Anterior end of the ventral surface of the skull of *Cogia breviceps* (× ¾), showing the paired premaxillary nodules (*X*) carrying the teeth (*t*). *gr.*, maxillary groove. *mx.*, maxilla. *pmx.*, premaxilla. *vo.*, vomer.

2. The external surface of the last two ribs (× ¾) showing what is believed to be the true position of the rudimentary (13th) rib in relation to the 12th. The cartilaginous lower end of the rib is dotted; the upper region—indicated by dotted outline—is the presumed continuation of the rib to its articulation with the vertebra. At the side of each rib is shown the outline of its transverse section (*a*).

3. View of the anterior side of the 13th rib. × 1.

Plate III.

Fig. 4. Sternum of *Cogia breviceps*, with the sternal ribs, dorsal aspect. × ⅓.

5. Hyoid, of which only the right anterior cornu is represented, dorsal aspect. × ⅓.

Plate IV.

Fig. 6. The right scapula, external surface. × ½.

7. The right pectoral limb, external surface. Some of the distal cartilages have been inserted from the more perfect left limb. × ¼.

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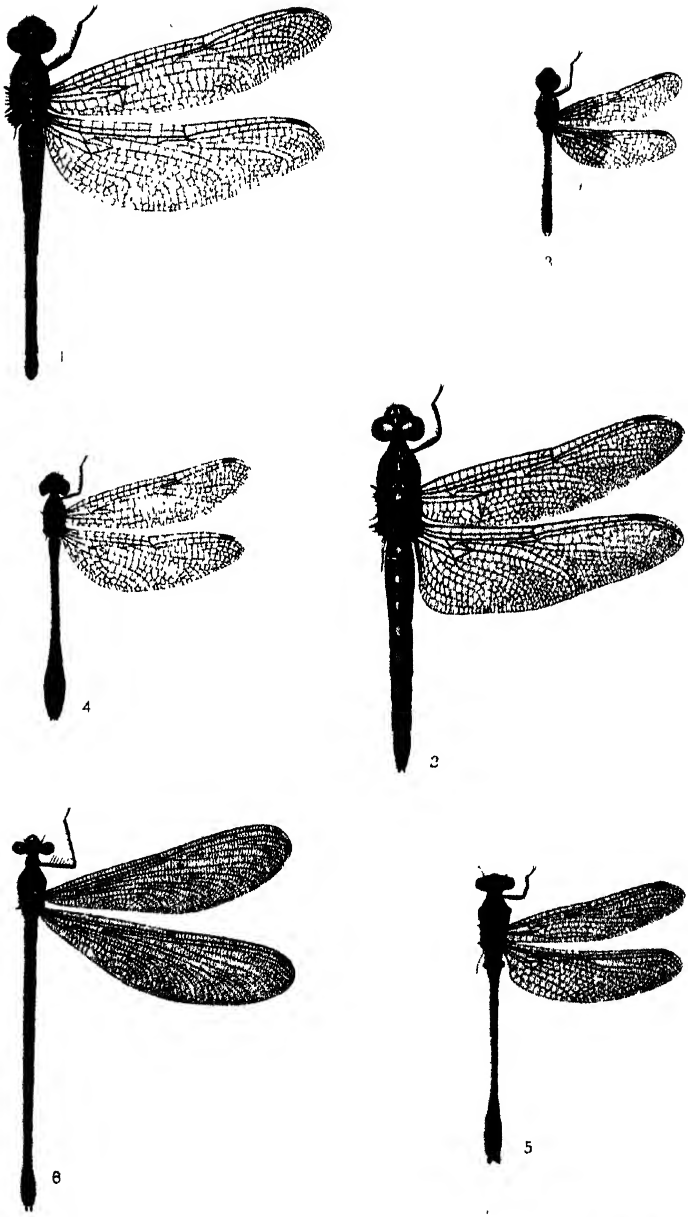
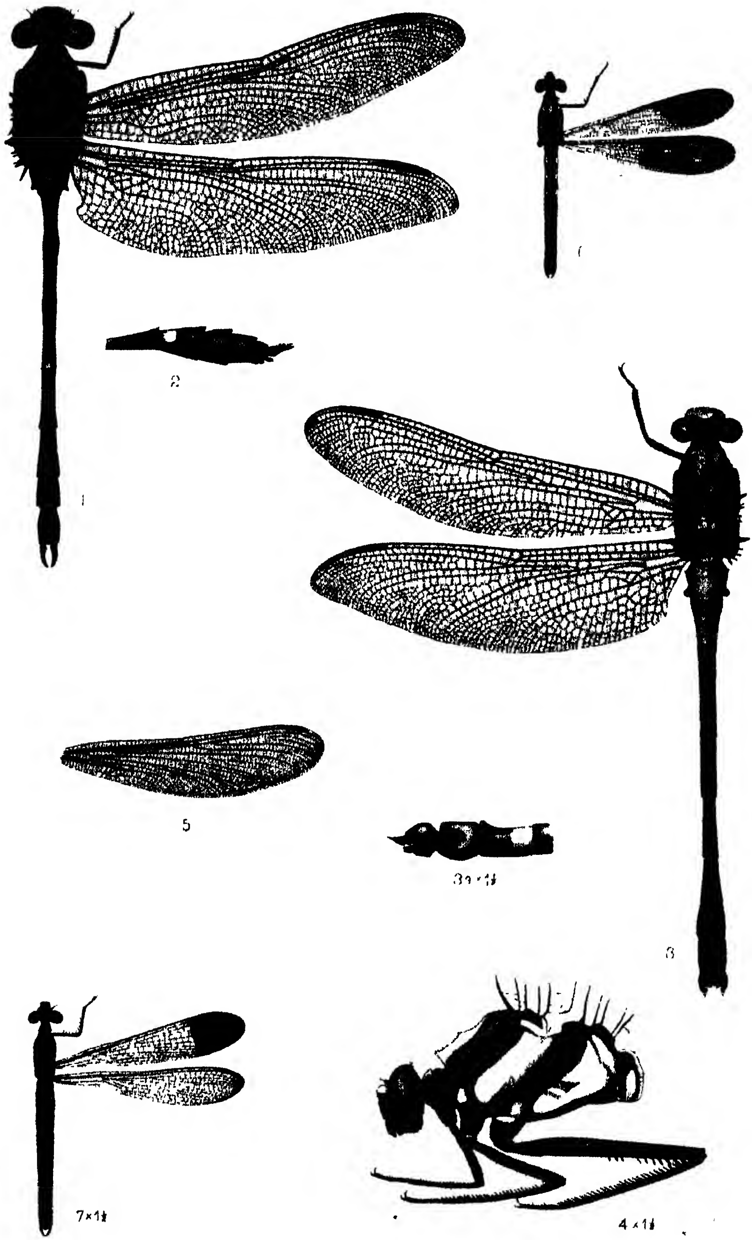
[1] Some of the terminal cartilages were imperfect on this hand, and have been restored in gelatine, but not quite accurately.



Edwin Wilson, Cambridge

DRAGONFLIES FROM THE MALAY PENINSULA.



Figs 1, 2, 5 A Brimble del Edwin Wilson, Cambridge

DRAGONFLIES FROM THE MALAY PENINSULA.

2. On a Collection of Dragonflies made by Members of the Skeat Expedition in the Malay Peninsula in 1899–1900. By F. F. Laidlaw, B.A.

[Received December 28, 1901.]

(Plates V. & VI.[1] and Text-figures 10–12.)

In drawing up an account of the Dragonflies collected by members of the Skeat Expedition, I have thought it worth while to include in my list not only the names of species represented in this collection, but also of all those which I have been able to find recorded as having occurred in the Malay Peninsula. It will be seen that the list is a fairly large one, although it is impossible to suppose that the full richness of the fauna of this part of the world has been as yet revealed.

Noticeably this is the case with the *Gomphinæ*; it is worthy of remark that our collection contained five specimens representing four different species, and that none of these were identical with any species previously found in the Peninsula. I have been able through the courtesy of Mr. Kirby to add to my list the names of the species taken by Mr. Ridley, specimens of which are in the British Museum. I have to thank both Mr. Kirby and Dr. Sharp very sincerely for many useful suggestions and much kind assistance.

Lastly, I have to thank the other members of the Expedition for their kind assistance in making the collection.

I have given references in every case where possible to Mr. Kirby's 'Catalogue of the Odonata,' published in 1890, where full allusion to papers published before that date will be found.

The following notes on the habits of some of the species collected may be of interest:—

Libellulidæ.—Almost without exception the numerous members of this family avoid forests and are to be found in flat open country, rice-fields, and clearings near the forests, especially where there happens to be a stagnant pool in the neighbourhood.

Certain very common and widely spread species are to be found wherever there is a suitable locality. Such are especially *Orthetrum sabina* and to a lesser extent *Pantala flavescens*, *Tholymis tillarga*, *Trithemis trivialis*, *Trithemis aurora*.

Certain other species with a very wide range in the Oriental Tropics seem to prefer the neighbourhood of the sea. Such are the members of the genus *Ryothemis*, also *Neurothemis tullia* and *Brachythemis contaminata*.

The rarer and more characteristic species are only to be found in up-country clearings. The only species that I saw actually in the forests were *Camacinia gigantea*, *Cratilla metallica*, *Tyrio-*

[1] For explanation of the Plates, see p. 92.

bapta torrida, *Orthetrum pruinosum*, and *Calothemis biappendiculata*. Others for the most part were caught playing round stagnant water. Rapidly running streams are invariably avoided except by *Tyriobapta torrida*.

On the other hand, the ÆSCHNIDÆ are mostly found in the forests, any small stagnant pool is an excellent locality; the species of *Gynacantha* and *Anax guttatus* are sometimes seen in the open. The large species of the *Gomphinæ* are also forest insects. Thus my specimen of *Sieboldius grandis* was taken in the same locality (a small muddy pool frequented by wild pig) with two males of *Amphiæschna ampla*; this locality also yielded *Pericnemis stictica* and *Lestes ridleyi*.

Another forest-haunting group is found amongst the CALOPTERYGIDÆ. *Vestalis amœna* never occurs in the open, nor over rapidly running water: probably *Echo* and *Climacobasis* have similar habits; they resemble *Vestalis amœna* so closely that they may perhaps be often mistaken for this very common species. The other *Calopteryginæ* are only to be found playing over rapidly running streams and rivers, and their beautiful iridescent wings add greatly to the charms of a sun-lit river-scene. *Rhinocypha fenestrella* sometimes forsakes the main stream for the shady rivulets that wander through the forest, but most of the species prefer the wider waters. The lovely *Neurobasis chinensis* wanders farther down the river perhaps than other species, but I have never seen it near the mouth of a river, or in fact after the stream had become sluggish and polluted.

Of the *Agrioninæ* numerous species are found in rice-swamps: few make their home in the forests, amongst these are *Pericnemis stictica* and *Lestes ridleyi* referred to above, as well as one or two species of *Psilocnemis*, *Amphilestes*, and a few of the *Protoneurous* group.

In many genera the females are exceedingly rare; this is especially the case with the Calopterygine genera *Euphæa* and *Dysphæa*. It has been suggested that the soberly coloured females do not attract the notice of collectors to the same extent as the males, and that hence they are rarely found in collections: but I can assert positively that in their own haunts the females are exceedingly rare; to the best of my belief, I saw only one, a female of *Euphæa ochracea*, which I secured.

Family LIBELLULIDÆ.

Subfamily LIBELLULINÆ.

(Species marked with an asterisk are not represented in our Collection.)

*ZYXOMMA PETIOLATUM Ramb.

Zyxomma petiolatum, Kirby, Cat. Odonata, p. 35.

East Indies. Singapore (*Ridley*).

THOLYMIS TILLARGA (Fabr.).

Tholymis tillarga, Kirby, Cat. Odonata, p. 1; Selys, Ann. Mus. Genov. (2) x. p. 439.

Common in the Eastern Tropics.

PANTALA FLAVESCENS (Fabr.).

Pantala flavescens, Kirby, Cat. Odonata, p. 1; Selys, Ann. Mus. Genov. (2) x. p. 440; Ris, Arch. f. Naturg. Jahrg. 66, p. 175.

Found in the tropics of both worlds.

CAMACINIA GIGANTEA (Brauer).

Camacinia gigantea, Kirby, Cat. Odonata, p. 2.

Two fine males were taken at Kwala Aring, where this species is fairly abundant near pools in open spaces. It is very difficult to catch, being a powerful flier. It haunted the same localities as *Neurothemis stigmatizans*, which resembles it very closely in colour, though of course much smaller.

HYDROBASILEUS EXTRANEUS (Hagen).

Hydrobasileus extraneus, Kirby, J. Linn. Soc., Zool. xxiv. p. 547, pl. xli. fig. 1, ♀.

Recorded from Penang.

RHYOTHEMIS PHYLLIS (Sulz.).

Rhyothemis phyllis, Kirby, Cat. Odonata, p. 5; id. Journ. Linn. Soc., Zool. xxiv. p. 549; Selys, Ann. Mus. Genov. (2) x. p. 443.

This species is common along the east coast of the Peninsula. Specimens were collected at Singgora, Kota Bharu, Kelantan, and at Trengganu. Occurs throughout the Malay Archipelago.

*RHYOTHEMIS FULGENS Selys.

Rhyothemis fulgens, Kirby, Cat. Odonata, p. 6.

Singapore (*Selys*); Dindings (*Ridley*). Borneo, Malay Peninsula, Sumatra.

*RHYOTHEMIS CURIOSA Selys.

Rhyothemis curiosa, Kirby, Cat. Odonata, p. 6.

Singapore (*Selys*). Sumatra. Perhaps a race of *R. fulgens* (Selys, Ann. Mus. Gen. xxvii. p. 451).

*NEUROTHEMIS FULVIA Drury.

Neurothemis fulvia, Kirby, Cat. Odonata, p. 7.

Neurothemis sophronia, Selys, Ann. Mus. Genov. xiv. (1879) p. 292.

Malacca (*Selys*). China, Bengal, Nepaul.

NEUROTHEMIS FLUCTUANS (Fabr.).

Neurothemis fluctuans, Kirby, Cat. Odonata, p. 7; Selys, Ann.

Mus. Genov. (2) x. p. 446; Karsch, Abh. v. d. Senckenberg. nat. Gesell. xxv. 1. p. 219.

Common at Kwala Aring. Widely spread in the Eastern Tropics.

Neurothemis stigmatizans (Fabr.).

Neurothemis stigmatizans, Kirby, Cat. Odonata, p. 7; Karsch, Abh. v. d. Senckenberg. nat. Gesell. xxv. 1. p. 218.

Plentiful at Kwala Aring. Like the last a common and variable insect.

Neurothemis disparilis Kirby.

Neurothemis disparilis, Kirby, Cat. Odonata, p. 8.

Two specimens from Kwala Aring. Singapore (*Ridley*); Borneo.

Neurothemis tullia (Dru.).

Neurothemis tullia, Kirby, Cat. Odonata, p. 8; id. Journ. Linn. Soc., Zool. xxiv. p. 550.

Common near the mouth of the Kelantan River and for some thirty miles up the river. A common Eastern species.

Trithemis (?) trivialis (Ramb.).

Trithemis trivialis, Kirby, Cat. Odonata, p. 18; id. Journ. Linn. Soc., Zool. xxiv. p. 550 (1894).

Trithemis (?) *trivialis*, Selys, Ann. Mus. Genov. (2) x. p. 467 (1891); Kirby, Ann. & Mag. Nat. Hist. (7) v. p. 531 (1900).

Diplacodes trivialis, Karsch, Abh. v. d. Senckenberg. nat. Gesell. xxv. 1. p. 219.

Widely distributed, ranging from India and Ceylon to Japan. I obtained specimens at Kwala Aring and Kota Bharu, Kelantan. Taken also by Mr. Ridley in Province Wellesley.

As pointed out by Mr. Kirby (Ann. & Mag. *loc. cit.*), this species probably requires the creation of a new genus to receive it.

Trithemis aurora (Burm.).

Trithemis aurora, Brauer, Verh. zool.-bot. Ges. Wien, xviii. p. 117 (1868); Selys, Ann. Mus. Genov. (2) x. p. 465 (1891).

Trithemis intermedia, Kirby, Proc. Zool. Soc. 1886, p. 327, pl. 33. fig. 4.

Trithemis yerburii, Kirby, Cat. Odonata, p. 18.

Trithemis aurora, Kirby, Journ. Linn. Soc., Zool. xxiv. p. 551.

This beautiful species was fairly common in September in marshy rice-fields at Ulu Aring. Mr. Ridley has collected it in Singapore.

Brachythemis contaminata (Fabr.).

Brachythemis contaminata, Kirby, Cat. Odonata, p. 21; id.

Journ. Linn. Soc., Zool. xxiv. p. 551; Selys, Ann. Mus. Genov. (2) x. p. 468 (1891).

A widely spread Oriental species; common on the lower reaches of the Kelantan River and in the town of Trengganu.

CROCOTHEMIS SERVILIA (Drury).

Crocothemis servilia, Kirby, Cat. Odonata, p. 21; Selys, Ann. Mus. Genov. (2) x. p. 468 (1891).

Kwala Aring in August, in an open space near forest. East Indies and Australia.

BRACHYDIPLAX MARIA Selys.

Brachydiplax maria, Kirby, Cat. Odonata, p. 22.

Kwala Aring. Dindings and Selangor (*Ridley*). Borneo.

*BRACHYDIPLAX MELÆNOPS Selys, Ann. Mus. Genov. xxvii. p. 457.

Brachydiplax melanops, Kirby, Cat. Odonata, p. 22.

A small species from Selangor taken by Mr. Ridley, and now in the British Museum, probably belongs to the species indicated by de Selys, agreeing with it in its small size. Abdomen 16·5 mm. long; hind wing 22·5. The thorax and first fore segments of abdomen blue-pruinose. 6 prenodals and 5 postnodals on the fore wing. Internal triangle free.

BRACHYDIPLAX PRUINOSA, sp. n.

Length of abdomen 18·5 mm. Length of hind wing 24 mm.

♂. *Head* yellowish grey, margins of the upper and lower lips black, frontal tubercle, and upper surfaces metallic blue. Eyes brown.

Prothorax and *thorax* coppery green dusted over with very pale blue 'bloom.' *Abdomen*: first five segments grey, also coated with 'bloom,' the rest black, second and third segments with a transverse carina; legs black; pterostigma and venation black.

Fore wings: 8 antenodals, 6 or 7 postnodals. Discoidal triangle free, followed by two rows of cells.

Hind wings: 7 antenodals, 6 or 7 (usually 7) postnodals. The hind wings have a faint tint of yellow at their base.

Two males from Kwala Aring taken in August.

*MICRODIPLAX DELICATULA Selys.

Microdiplax delicatula, Kirby, Cat. Odonata, p. 22.

MACRODIPLAX VITTATA Kirby.

Urothemis vittata Kirby, Journ. Linn. Soc., Zool. xxiv. p. 552, pl. 42. fig. 2.

A male specimen from Kwala Aring. Mr. Kirby tells me that this species should be referred rather to the genus *Macrodiplax*

than to *Urothemis*. The last postnodal cell is as long or a little longer than the pterostigma in the fore wing.

TYRIOBAPTA TORRIDA Kirby.

Tyriobapta torrida, Kirby, Cat. Odonata, p. 32; Karsch, Abh. v. d. Senckenberg. nat. Gesell. xxv. 1. p. 221 (1890).

This species haunted a small forest stream close to the village of Kwala Aring. It was apparently confined to this locality in that neighbourhood. A common Bornean insect.

CRATILLA METALLICA (Brauer).

Protorthemis metallica, Kirby, Cat. Odonata, p. 30; Selys, Ann. Mus. Genov. (2) x. p. 461; Karsch, Abh. v. d. Senckenberg. nat. Gesell. xxv. 1. p. 221.

Nesoxenia metallica, Kirby, Cat. Odonata, p. 180.

Cratilla metallica, id. Ann. & Mag. Nat. Hist. (7) v. p. 542.

Common at Kwala Aring and on Gunong Inas.

ORTHETRUM SABINA (Ill.).

Orthetrum sabina, Kirby, Cat. Odonata, p. 35.

Abundant all along the East Coast. Ranges through the East Indies to Australia.

ORTHETRUM PRUINOSUM (Burm.).

Orthetrum pruinosum, Kirby, Cat. Odonata, p. 38; Ris[1], Arch. f. Naturg. Jahrg. 66, p. 185, pl. ix. fig. 3.

A single specimen (♂) from Kwala Aring, September 1899. East Indies.

ORTHETRUM TESTACEUM (Burm.).

Orthetrum testaceum, Kirby, Cat. Odonata, p. 39.

A pair, *in cop.*, from Kwala Aring, September. Also a single male from the same locality. Recorded from Java.

ORTHETRUM NICEVILLEI Kirby.

Orthetrum nicevillei, Kirby, Ann. & Mag. Nat. Hist. (6) xiv. p. 112 (1894).

Described from specimens from Tenasserim. A single specimen from Ulu Aring, September 1899.

ORTHETRUM sp.—Our collection includes a female *Orthetrum* belonging to a species distinct from, but closely allied to, *O. sabina*. The abdomen is shorter, 26 mm., and distinctly stouter, the anal appendages are black, and the sides of the thorax are not so distinctly marked with black. I have been unable to identify it.

LYRIOTHEMIS PRIAPEA Selys.

Lyriothemis priapea, Kirby, Cat. Odonata, p. 25.

This genus is closely allied to *Orthetrum*, but differs in the

[1] Dr. Ris (*loc. cit.*) records *O. chrysis* from Malacca.

strongly curved sectors and in having three or four cross nervules in the submedian space of fore and hind wings.

A single specimen, a male, from Kwala Aring.

POTAMARCHA OBSCURA (Ramb.).

Potamarcha obscura, Kirby, Cat. Odonata, p. 180.

Potamarcha congener, Selys, Ann. Mus. Genov. (2) x. p. 459.

Potamarcha obscura, Karsch, Abh. v. d. Senckenberg. nat. Gesell. xxv. 1. p. 219.

This species is common at Kwala Aring, where I took two females and several males. Closely allied to *Lathrecista*, it differs in having the eighth abdominal segment in the female dilated, and the triangle of the hind wing traversed. (See also Selys, *loc. cit.*)

LATHRECISTA TERMINALIS Kirby.

Lathrecista terminalis, Kirby, Cat. Odonata, p. 30.

A single male from Kwala Aring. Recorded and described from Borneo.

*LATHRECISTA SIMULANS (Selys).

Lathrecista simulans, Kirby, Cat. Odonata, p. 30; Selys, Ann. Mus. Genov. (2) x. p. 458.

Recorded from Borneo, Sumatra, Ceylon, Malacca, and Burmah.

*AGRIONOPTERA LINEATA Brauer.

Agrionoptera lineata, Kirby, Cat. Odonata, p. 31; Selys, Ann. Mus. Genov. xix. (1879) p. 302.

Malacca. Philippines.

*AGRIONOPTERA MALACCENSIS Selys.

Agrionoptera malaccensis, Selys, Ann. Mus. Genov. xxvii. p. 461; Kirby, Cat. Odonata, p. 31.

(This genus differs from the preceding in the absence of the supernumerary antenodal nervule of the front wings, and in having several cross nervules in the submedian space, as well as in the position of the base of the triangle of the hind wings, in front of the arculus. The two genera closely resemble each other in coloration.)

*AGRIONOPTERA NICOBARICA Brauer.

Agrionoptera nicobarica, Kirby, Cat. Odonata, p. 31.

Singapore, Nicobar Is.

*AGRIONOPTERA SEXLINEATA Selys.

Agrionoptera sexlineata, Kirby, Cat. Odonata, p. 31.

Recorded from Malacca.

*CALOTHEMIS BIVITTATA (Ramb.).

Calothemis bivittata, Kirby, Cat. Odonata, p. 42.

CALOTHEMIS BIAPPENDICULATUS Selys.

Calothemis biappendiculatus, Kirby, Cat. Odonata, p. 42.

♂. Length of abdomen 22 mm. Length of hind wing 28 mm. Wings hyaline, slightly tinged with yellow at their bases. Pterostigma black, 2 mm. in length, covering 3 cells.

Fore wing. 19 antenodals, the last continuous, 9–10 postnodals. Discoidal triangle traversed, followed by two rows of cells. 2 supra-triangular cross nervules, 2 cross nervules in the lower basal cell. Internal triangle divided into 3 cells.

Hind wing. 2 supra triangular, 3 lower basal cross nervules. Discoidal triangle traversed.

Head. Lower lip yellow, upper lip black, eyes brown, occipital triangle black, rest of head steely-blue black except a yellow mark at the side behind each eye.

Prothorax black.

Thorax black above, dull brown below. Legs brown.

Abdomen. Segments 1 and 10 black, the rest bright red. Segments 2 3 with transverse carina. Segments 3 9 strongly triangular in cross section. Rising from the bases of the genital ramules are two long branches, standing at right angles to the body.

♀ unknown.

I took two specimens of this insect at Kwala Aring. They differ from the type in having the upper surface of the thorax rich black instead of brown. Otherwise they closely resemble it, especially in the very remarkable genital organs on the second abdominal segment.

*ORCHITHEMIS PULCHERRIMA Brauer.

Orchithemis pulcherrima, Kirby, Cat. Odonata, p. 42; Karsch, Abh. v. d. Senckenberg. Nat. Gesell. xxv. 1. p. 228.

Singapore (*Ridley*). Malacca (*Selys*).

DIPLACODES NEBULOSA (Fabr.).

Diplacodes nebulosa, Kirby, Cat. Odonata, p. 42.

A single specimen was taken at Kota Bharu, Kelantan. There are specimens in the British Museum taken by Ridley in Province Wellesley. Widely distributed in the East Indies.

ACISOMA PANORPOIDES Ramb.

Acisoma panorpoides, Kirby, Cat. Odonata, p. 43.

Kwala Aring. One specimen, ♂. Tropical regions of the Old World.

TETRATHEMIS HYALINIA Kirby.

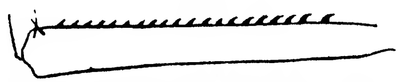
Tetrathemis hyalinia, Kirby, Cat. Odonata, p. 44.

The two species of this genus which are represented in our collection exhibit a very remarkable sexual dimorphism which has not, I believe, previously been remarked. The males have a

very extraordinary development of the armature of the second and third pairs of femurs. This development is paralleled in the American genus *Macrothemis* and its allies and also in the Old World genera *Schizonyx*, *Neurocena*, *Zygonyx*, and *Zygonidia*, amongst other *Libellulinæ* (see Calvert, Pr. Ac. Philad. 1899, p. 246).

Tetrathemis hyalinia has in the male, on each of the second pair of femurs, on their antero-inferior surface, 17 short straight spines directed towards the knee, increasing gradually in size, but the last three longer than the rest, more widely separated and increasing rapidly. On the antero-inferior surface of each of the third pair of femurs is a row of some 20 short curved teeth, their apices directed away from the knee, decreasing gradually in size distally; at the end of the series is a single short straight spine directed towards the knee (see text-fig. 10).

Text-fig. 10.



Third femur of *Tetrathemis hyalinia* (× about 10).

TETRATHEMIS PULCHRA, sp. n. (Plate V. fig. 3.)

Length of abdomen, ♂ 16 mm., ♀ 15 mm. Length of hind wing, ♂ 17 mm., ♀ 17·5 mm.

Wings hyaline, reticulation black. Fore wings tinged with orange from the base about halfway to the nodus. Hind wings tinged with orange about as far as the nodus.

Fore wings. 8–9 (usually 8) antenodals, 5 (in one case on one side 6) postnodals; 1 supra-triangular cross nervule; 2 cross nervules in the lower basal cell. Triangle followed by a single row of cells.

Hind wings. 6 or 7 (usually 7) antenodals, 5 postnodals; no supra-triangular cross nervule; 2 cross nervules in lower basal cell.

Coloration in the male. Face black with yellow marks as follows: lateral lobes of lower lip, nasus, and rhinarium. The vertex and tubercle are metallic coppery black. Back of *head* and *prothorax* black.

Thorax black above, a few yellow spots between the wings. Sides citron-yellow with two black bands. The first of these runs from immediately in front of the first pair of wings obliquely downwards to between the second and third pair of femurs. The second runs from immediately in front of the second pair of wings down behind the third pair of femurs. The whole ventral surface is black, save that the yellow colour of the flanks extends for a short distance over the ventral surface along either side The legs are black, inner surface of first pair of femurs citron-yellow.

Abdomen black, with the following yellow marks:—a spot on either side of segments 1–6, very small on 6, traversed by a black

line following the transverse carina in 3–4. On segment 7 a dorsal yellow spot divided longitudinally by the black mid-dorsal carina. Traces of a transverse carina are present on segment 5. The abdomen is slightly dilated at its base, but from segment 4 onwards very slender.

Coloration in the female as in the male. The traces of a transverse carina in segment 5 are more distinct laterally. The abdomen is broader and of practically equal circumference throughout.

In the male there are on the antero-inferior surface of the femur 17 short curved teeth directed towards the knee, and increasing in size distally very gradually. These are followed by three straight spines inclined in the same direction; the first of these is the shortest and the last the longest.

The third femur is provided on the antero-inferior surface with a row of 23 thorn-like teeth with their apices directed away from the knee. These increase gradually towards the distal end of the femur.

*NANNOPHYA PYGMÆA Ramb.

Nannophya pygmæa, Kirby, Cat. Odonata, p. 45.

The British Museum has a number of specimens of this species from Singapore.

Genera of uncertain position.

NEUROCENA IDA Hagen. (Plate V. fig. 1.)

Zygonyx ida, Hagen, Ver. Ges. Wien, xvii. p. 62; Brauer, op. cit. xviii. p. 370 & p. 742; Selys, Ann. Soc. Ent. Belg. xii. p. 96; id. Ann. & Mag. Nat. Hist. (4) iii. p. 274; id. C. R. Soc. Ent. Belg. xxxv. p. ccxxvii.

Pseudomacromia luxuriosa, Karsch, Berl. ent. Zeitschr. xxxviii. p. 21.

Zygonyx ida, id. Ent. Nachr. xxi. p. 203; Calvert, P. Ac. Philad. 1899, p. 246.

Neurocena ida, Kirby, Ann. & Mag. Nat. Hist. (7) v. p. 541.

This appears to be an exceedingly variable species, and the single specimen I obtained differs to a certain extent from those described hitherto, so that it seems worth while to give a fairly full account of it.

The length of the hind wing is 42 mm., of the abdomen 38 mm.

The wings are hyaline, faintly tinged with yellow, which becomes vivid towards the outer extremities of the fore wings. In a male in the British Museum Collection the wings are almost colourless. The reticulation is black.

Fore wings. 14 antenodals; on the left side the outermost is continuous, on the right side discontinuous. 7 to 8 postnodals. *Internal triangle of both wings free*, discoidal triangle free. (The internal triangle is usually divided into two or three cells; de Selys states that in two females examined the discoidal triangle

is free, in three females crossed; in males it is normally free.) Two rows of post-triangular cells. Nodal sector strongly waved at its middle. Arculus at the level of the second antenodal. Two cross nervules in the submedian space.

Hind wings. 10-11 antenodals, 9 9 postnodals. Discoidal triangle traversed. (According to de Selys the discoidal triangle of the hind wing in the female is normally traversed; of 13 males 7 had it traversed and 6 free.) The triangle is followed by two rows of cells. The British Museum specimen (male) has but one row of post-trigonal cells in the hind wings. Pterostigma in the females is about 3·75 mm. long, in the male about 2·25 mm. Sectors of triangles of hind wings widely separated at their origins.

Rhinarium and nasus livid yellow. Frons and vertex metallic blue-green. Thorax metallic blue-green. Abdomen slightly thickened at its base, metallic black with fine transverse yellow lines at the bases of segments 2 and 3 and on the transverse carinæ of those segments. A yellow spot on either side of the second segment.

Legs black. In the males on each of the second pair of femurs are a number of short teeth directed towards the knee. On the third pair are 25 short teeth; of these the first eight or nine are directed towards the knee, then follow one or two not inclined, then eleven or twelve directed towards the trochanter, last one or two not inclined. In the females all the teeth on the hinder femurs are directed towards the knee.

ZYGONIDIA MALAYANA, sp. n.

Length of abdomen 34·5 mm. Length of hind wing 42 mm. Length of pterostigma 3·75 mm. Breadth of hind wing 13 mm.

Wings hyaline, reticulation black, pterostigma black, membranule brownish grey.

Fore wings. 16 antenodals, the last on the right side is discontinuous, that on the left continuous. 9 postnodals. Internal triangle divided into three cells, discoidal triangle crossed by a single nervule and followed by three rows of cells. Nodal sector waved at its middle. Two cross nervules in lower basal cells. Arculus between the level of the first and second antenodal.

Hind wings. 10–11 antenodals, 10-11 postnodals. Discoidal triangle traversed, followed by two rows of cells. Sectors of triangle scarcely separate at their origin. Lower basal cell with a single cross nervule.

Head. Labrum black, bases of the mandibles bright yellow. Rhinarium dull yellowish brown, nasus black along its ventral margin, for the rest yellow. Genæ yellow. Frons and tubercle metallic violet, but frons yellow at the sides. Tubercle truncate anteriorly, occipital triangle black.

Prothorax brown, posterior lobe with a rounded backwardly directed projection at the middle of its posterior margin.

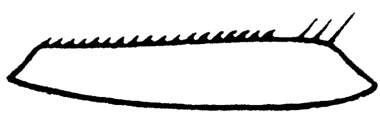
Thorax metallic green, marked with dull yellowish brown as follows:—a fine line along the mid-dorsal carina; a lateral band

running from the second and third femora to between the wings. The whole ventral surface is yellowish brown, and this colour extends for a short distance along the humeral suture and on to the sides of the metasternum. Between the wings dorsally are three yellow spots, one behind the other.

Abdomen black, very slightly dilated at its base. Yellow lateral spots on segments 1, 2, 3. Base of segments 2, 3, 4 with a fine transverse yellow line; mid-dorsal carina with a scarcely perceptible yellow line from segments 3 to 7. Longitudinal yellow marks ventrally on segments 3, 4, 5 on either side of the middle line. Anal appendages black. Transverse carinæ on segments 2, 3. On segment 2 there is on either side anteriorly a small tuft of fine black hairs.

Legs black. In the male the second pair of femurs have each a row of 18 antero-inferior short spines directed towards the knee, and increasing in size gradually from above downwards. These are followed after a short gap by three long straight spines which are also directed a little downwards (see text-fig. 11). The third pair of femurs have each 26 antero-inferior short subequal spines all directed towards the knee, save the last six, which are not inclined. Then follow two longer spines inclined towards the knee.

Text fig. 11.



Second femur of *Zygonidia malayana.*

This species differs from *Zygonyx iris* chiefly in that the discoidal triangle of the lower wing is followed by two rows of cells, not by three; and in the absence of any dorsal markings on segment 7 of the abdomen, in the coloration of the thorax, and length of the pterostigma. It is more closely allied to *Zygonidia insignis* (Kirby, A. M. N. H. (7) v. p. 540), from which it is chiefly distinguished by its smaller size, the fewer reticulations in the postnodal spaces of the hind wings, and in the details of the spines on the second and third pairs of femurs of the male. In *Z. insignis* the second pair of femurs have each a row of 18 antero-inferior spines, followed by three much longer spines. The first 12 are directed towards the knee, the next six are not inclined, the three long spines are slightly inclined towards the knee. The third pair of femurs have each some 24 short spines, the first 14 inclined towards the knee, the last 10 scarcely inclined, followed by two longer spines inclined to the knee.

I caught two specimens of *Zygonidia malayana* at Kwala Aring in September. These, like all the other recorded specimens

belonging either to the genus *Zygonidia* or to *Zygonyx*, are both males.

The character of the last antenodal cross nervule seems to be very variable. In one specimen of *Zygonyx iris* it is accidentally complete (de Selys, C. R. Soc. Ent. Belg. xxxv. p. ccxxvii). In one of the two known specimens of *Zygonidia insignis* it is accidentally incomplete on one side (Kirby, A. M. N. H. (7) v. p. 540). On one side of both specimens described above it is incomplete, on the other complete.

These two preceding species, together with their allies, probably constitute a separate section of the *Libellulinæ* approximating somewhat closely to the *Corduliinæ*. See Calvert, *loc. cit.*

ONYCHOTHEMIS TESTACEA, sp. n. (Plate V. fig. 2.)

Length of abdomen 33·5 mm. Length of hind wing 40 mm. Length of anal app. of ♂ 2·5. Breadth of hind wing 13·5 mm.

Wings hyaline, reticulation black. Pterostigma 4 mm. long.

Fore wings. 15 antenodals, 10–11 postnodals. Internal triangle divided into three cells. Discoidal triangle narrow, with a single cross vein, followed by three rows of cells: no supra-triangular nervule. Nodal sector waved, a single cross nervule in the lower basal space: membranule long, grey. Upper sector of triangle curved. Sectors of arculus stalked.

Hind wings. 9–10 antenodals, 11 postnodals. Discoidal triangle free, followed by two rows of cells. Lower basal cell with a single cross nervule. Sectors of triangle originate close together. Nodal sector waved.

Head. Ventral surfaces yellow, with a triangular black mark in the centre, its apex directed forwards. Upper lip black, with a reddish-brown spot on either side. Rhinarium and nasus reddish brown, with a black mark along the suture between them. Frons yellow below, steely black above. Frontal tubercle bifid, steely black. Occipital triangle black.

Prothorax black, with a yellow hinder margin.

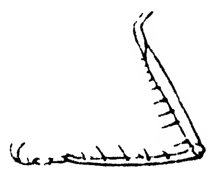
Thorax dark metallic green, the mid-dorsal carina and a mid-dorsal line between the wings yellow. Two small orange-yellow spots on the humeral sutures on either side, the one above the other. A thin yellow band runs from immediately behind the front pair of wings downwards to between the second and third pairs of legs on either side. An orange line runs along the outer edge of the metasternum. Ventral surface black.

Abdomen broad, slightly dilated at its base. Segments 4 to 8 strongly triangular in section. Testaceous black with dull yellow markings. Mid-dorsal spots on the middle of segments 1 to 8. Segments 2 and 3 with a yellow-marked transverse carina; the yellow mark is discontinuous dorsally in 2, but in 3 runs into the yellow spot. Ventrally each segment from 3 to 8 has two large oblong yellowish spots on either side of the middle line. These spots extend round the lateral keel on to the sides of the abdomen and on segment 7, 8 reach to within a short distance of

the dorsal spots. Segments 9 and 10 black, segment 10 is very small. Upper appendages black, curved slightly inwards and at first downwards, but at their distal ends they turn up a little. About halfway along their ventral sides is a small tooth. Ventral appendage black, rather broad and flat, bifid at its extremity, not more than two thirds the length of the upper pair.

Legs black. On each of the first pair of femurs is a single spine immediately before the knee. In the second pair on each are three long pairs of spines inclined towards the knee and distant from each other. On each of the third pair of femurs are 4 pairs of large spines, rapidly increasing distally, followed after a gap by a single pair. All inclined slightly towards the knee. On the first pair of tibias are three pairs of long equidistant spines, on the second and third pair of tibias are four pairs of large spines. (See text-fig. 12.)

Text-fig. 12.



Third leg of *Onychothemis testacea* (× 1½).

A single male from Kwala Aring.

This species differs from *Onychothemis abnormalis* (Brauer, Verh. Ges. Wien, xviii. p. 170) in having no transverse carina on the fourth abdominal segment, and in having the claws of the third pairs of legs without any sign of a tooth. I have not been able to examine a specimen of *O. abnormalis*, a Philippine Is. species, but the present species is evidently closely allied to it.

This genus appears to stand quite remote from other Libellulids, not only in the absence of a tooth on the basal claws, but in the remarkable armature of the femurs. The two species of the genus should form an independent subsection of the *Libellulinæ*.

Corduliinæ.

Two members of the subfamily are known to occur in the Peninsula; these are *Macromia westwoodi*, Selys, and *Idionyx yolanda*, Selys. To these can now be added *Macromia gerstaeckeri*, recently described by Krüger from Java (Krüg., Stett. ent. Zeit. 1899, p. 335), and *Idionyx dohrni* (loc. cit. p. 326) from Sumatra.

Macromia gerstaeckeri Krüger.

Macromia gerstaeckeri, Krüger, Stett. ent. Zeit. 1899, p. 335.

I caught a pair of a species of *Macromia*, which I refer to this

species, at Kwala Aring in September 1899. The male is very young.

	♂.	♀.
Length of abdomen (without appendages).	36 mm.	37·5 mm.
Hind wing	32	34
Pterostigma	2	2

♂. Antenodal nervures of fore wing 14, postnodal 7, 3. Antenodal nervures of hind wing 11, postnodal 7, 8. Supra-triangular nervures of fore wing 3 or 4, of hind wing 2. Nerves of median space of fore wing 6, of hind wing 4.

The *head* in this specimen is badly shrivelled, and it is difficult to make out the characters for the most part; the yellow 'nasus' is obvious.

Prothorax dull brown. *Thorax* iridescent brown, with three yellow lines on each side. The antehumeral band begins at the base of the coxæ of the first pair of legs and runs about halfway up the thorax. The middle line commences behind the middle pair of legs and runs up to behind the front pair of wings, running right across the back to join that of the other side. The hinder stripe runs along the hinder outer margin of the abdomen, starting from behind the last pair of legs. The coxæ of the first pair of legs are yellow, as also the hinder surface of those of the second and third pairs.

The *abdomen* is dull brown; segments 1-3 and 7-10 a little expanded. It has yellow markings as follows:—base of the first segment shading gradually into dull brown at its hinder end, second segment has a yellow ring covering its anterior half; third segment has two very small dorsal spots lying very close together just behind the middle of the segment; seventh segment with a transverse dorsal band taking up the anterior fifth of the segment.

Anal appendages subequal, or the inferior a very little larger than the two upper, about 3 mm. long, as long as the last two segments. The upper pair have each at about two-thirds of their length a small tooth on the outer side.

♀. *Head* and *thorax* as in the male, but the iridescent brown is replaced in the more adult female by rich metallic green. The wings have a number of vague brown marks on their outer halves.

Abdomen. Segments 1-6 metallic black, 7-10 dull black. Yellow markings as follows:—second segment a long spot on either side, a transverse line along its anterior margin dorsally, two small dorsal spots at about the middle of the segment; 3 with a line on either side along its lateral anterior margin not reaching the dorsal surface; 7 as in the male, but the yellow mark is broader, covering about one-fourth of the segment.

As Krüger has pointed out (*loc. cit.*), *M. gerstaeckeri* differs from its allies in its smaller size; and in the position of the small second tooth of the superior anal appendages of the male from the

other species possessing this character (*M. cincta* Rambur, *westwoodi* Selys, *borneensis*, *fumata* Krüger), in which the tooth lies at the middle of the length of the appendage.

IDIONYX DOHRNI Krüger. (Plate V. fig. 4.)

Idionyx dohrnii, Krüger, Stett. ent. Zeit. 1899, p. 326.

♀. Length of abdomen 26 mm. Length of hind wing 26·5 mm.; breadth 8·5.

Triangles of all four wings undivided, those of the front wings with their anterior borders somewhat broken near their outer angle. Supra-triangular space crossed by a single nerve in all four wings. Triangles followed by a single row of cells; in the hind wings the nerve bordering the first cell of the row ends against the middle of the outer wall of the triangle, so that the second cell comes into contact with it (*cf.* characters of *I. optata* Selys, in Ann. Mus. Gen. (2) x. p. 472). On the margin of the wings this single row breaks up into 6 cells on the fore, 7 on the hind wings. The median space in the fore wing is traversed by a single nerve; hinder wing with two nerves in the median area. Sectors of arculus with very long stalk, rising in both front and hind wings almost in the angle made by the arculus and the submedian vein. Wings tinged with brownish yellow, which is darkest at the base.

Head brown, with the upper lip dull yellow. Vertex metallic blue. *Thorax* brown-green, with three stripes on each side: the front one is yellow at the base of the front pair of legs, and fades into brown as it passes up along the thorax; the second and third are yellow. The abdomen is very dark brown, fading into black at the end; the ventral edge of all the segments except the first marginal with a fine yellow line, which is broadest on 2-3.

This species differs from all its congeners in having the median space of the lower wing traversed by two nerves. It is also a trifle smaller than the other species.

One female from Kwala Aring taken in September 1899.

I have given the characters of this and the preceding species rather fully because they show some points of variance with the types described by Krüger, and in the case of the first between the male and female.

Family ÆSCHNIDÆ.

Subfamily ÆSCHNINÆ.

ANAX GUTTATUS (Burm.).

Anax guttatus, Kirby, Cat. Odonata, p. 84.

One specimen from Kwala Aring. Widely distributed in the East Indies.

AMPHIÆSCHNA AMPLA (Ramb.).

Amphiæschna ampla, Kirby, Cat. Odonata, p. 93; Karsch, Ent. Nachr. xvii. (1891) no. 18, p. 10.

Two males of this species were taken at the foot of Gunong Inas. The larger specimen had its abdomen 64 mm. long, its hind wings each 62 mm. The upper pair of abdominal appendages measure 6·5 mm. This is a very handsome creature, the rich green and black thorax contrasting with the black yellow-ringed abdomen. Previously recorded from Java and Amboyna.

Tetracanthagyna plagiata (Waterh.).

Tetracanthagyna plagiata, Kirby, Cat. Odonata, p. 94.

Gynacantha plagiata, Karsch, Ent. Nachr. xvii. (1891) no. 18, p. 9.

I caught a female of this splendid species at Kwala Aring, in thick forest. It agrees very closely with the type specimen figured by Waterhouse, from Borneo (Proc. Ent. Soc. Lond. 1877, p. x; Trans. Ent. Soc. Lond. 1878, p. 119, fig. 4), but is somewhat smaller. The length of the hind wing is 69 mm., breadth 22 mm.; length of abdomen 56 mm.; breadth of head 15 mm. Recorded from Borneo and Sumatra.

My specimen has a small supernumerary spine on the right side in addition to the four normal spines on the end of the abdomen.

Gynacantha rosenbergii Brauer.

Acanthagyna rosenbergii, Kirby, Cat. Odonata, p. 95.

Gynacantha rosenbergii, Karsch, Ent. Nachr. xvii. (1891) no. 18, p. 9; Krüger, Stett. ent. Zeit. 1898, p. 278.

A single male and two females from Kwala Aring. Two other females probably belong to another species, but I have not been able to compare them with a series. They are from the same locality as the rest.

*Jagoria pœciloptera Karsch.

Jagoria pœciloptera, Kirby, Cat. Odonata, p. 91; Krüger, Stett. ent. Zeit. 1898, p. 329.

Recorded by Krüger (*loc. cit.*) from Singapore.

Subfamily Gomphinæ.

Apparently only three species of Gomphine Dragonflies have hitherto been recorded from the Peninsula. These are:—

Legion Gomphus.

Microgomphus chelifer Selys (Mt. Ophir, Sumatra).
Macrogomphus thoracicus McLach. (Perak).

Legion Lindenia.

Ictinus melanops Selys (Malacca).

Our collection contains five specimens referable to the following species:—

Legion Gomphus.

Gomphus consobrinus ♂ ♀, sp. n.

Onychogomphus geometricus, var. *nigrescens* n. (Kwala Aring, Kelantan), ♀.

Legion Gomphoides.

Sieboldius grandis (♂, Gunong Inas, Perak).

Legion Lindenia.

Gomphidia perakensis, sp. n. (♂, Gunong Inas, Perak).

Legion Gomphus.

Gomphus consobrinus sp. n. (Plate V. fig. 5.)

Length of abdomen 31 mm. Length of hind wing 26 mm. Length of pterostigma 2 mm.

Fore wing. No basal subcostal nervule. Sectors of the arculus distinct at their origin, then converging, meeting for a short distance, then diverging[1]. 11 antenodals, 10 postnodals. Pterostigma brownish black, thick. Triangles free.

Hind wing. 10 antenodals, 10 postnodals.

Reticulation black, membranule almost entirely absent.

General colour dull bronze-brown, lower surfaces of head and thorax greenish yellow. Dorsal surface of *thorax* dark brown, with two lighter submedian somewhat oblique bands diverging from each other from above downwards, each joining a lighter transverse antehumeral mark so as to make a 7 on either side. Sides of thorax lighter bronze.

Abdomen almost black, first segment greenish yellow; sides of second segment, a very fine dorsal longitudinal line on the second segment, and the auricles yellow. Segments 1, 2 somewhat dilated, 3 to 7 thin cylindrical, 8 to 10 dilated and progressively shorter.

Appendages black, upper pair of about the same length as the tenth segment, widely diverging from each other, turned up and pointed at their ends, each with a small tooth on the margin at about half its length. Lower pair diverging, rather shorter than upper pair, each terminating in a laterally directed point.

A male and a female were taken at Kwala Aring. The female had only very recently escaped from the larva and is too much withered to describe.

There seems no doubt that this is a true *Gomphus* belonging to Type A of Selys (Mon. Gomph. p. 376). The occurrence of a member of this group in such a locality is remarkable.

Onychogomphus geometricus nigrescens, var. n.

One ♀ from Kwala Aring, Kelantan.

Closely allied to *O. geometricus* de Haan.

Head, prothorax, and thorax as in *O. geometricus*.

Posterior surface of first pair of femurs *yellow*.

Abdomen black, marked with yellow as follows:—a dorsal band on the first and second segments, decreasing in size from before backwards, the sides of these segments are yellow. The auricles

[1] This feature is not shown in the figure.

are scarcely visible. Segments 3-7 have an incomplete basal orange ring, occupying in segment 3 about one-fourth of the segment, in 4 6 not more than one-sixth, and in 7 not more than two-fifths of the segment. Remaining three segments black, decreasing successively in size; anal appendages pointed, larger than the tenth segment, yellow.

Differs from the typical race in the smaller extent of the yellow marks on the abdomen. The yellow lozenge shaped dorsal spot on segment 3 is present, that on 4 is scarcely visible. The great length of the first two cells between the sectors of the arculus is remarkable. The cross nervule enclosing the third cell is beyond the level of origin of the principal sector.

Legion Lindenia.

Gomphidia perakensis, sp. n. (Plate VI. figs. 1, 2.)

Total length	78 mm.
Length of abdomen (without appendages)	54 ,,
Breadth of head........................	12·5 ,,
Length of hind wing..................	54 ,,
,, ,, fore wing	54 ,,
,, ,, pterostigma	8 ,,
Breadth of hind wing	14 ,,
Length of upper anal appendage...	4 ,,

Colour black with saffron yellow markings; wings hyaline, reticulation black.

Fore wing. 22 23 antenodals, 17 18 postnodals. Internal triangle divided into three cells; discoidal triangle into four. Membranule small, dark brown. Pterostigma long, black.

Hind wing. 15 16 antenodals, 20 21 postnodals. Internal triangle divided into three cells; discoidal triangle into four.

Head. Labium, mandibles, and labrum black; gena black, with a dull yellow spot. Rhinarium saffron-yellow; nasus black, with a saffron-yellow spot on either side. Anterior surface of frons black, horizontal surface yellow. Vertex and occiput black. The vertex has two conical projections, one on either side as in *G. T-nigrum*, but not so large relatively. *Prothorax* black.

Thorax black, with the following saffron-yellow marks:—In front dorsally a semicircle broken by the mid-dorsal carina. From the outer ends of the semicircle, but separated widely from them, a short broad band runs on either side to the ante-alar sinus, inclining towards the middle lines. Behind these on either side is a small spot, just below the sinus and immediately in front of the first pair of wings. Laterally are two large bands widely separated. The first pair run obliquely forward from below the first pair of wings; the second pair are rather smaller, and run obliquely forward from below the second pair of wings: neither pair reaches the ventral surface.

Dorsally between the wings there are brown marks and a

citron-yellow spot between the first pair of wings. Ventral surfaces and legs rich black. The legs are robust, rather short; hindermost pair of femurs with stout spines.

Abdomen somewhat dilated at its base, then segments 3 to 6 long and cylindrical, segments 7 to 9 compressed laterally, 10 very short. Black, with yellowish marks as follows:—on segment 2 a lateral spot, the auricles, and a very small dorsal lozenge-shaped mark. Segment 3 has a trace of a yellow spot on either side and a very fine mid-dorsal line. The basal third of segment 7 with a large dorsal mark. Anal appendages black, resembling those of *G. T-nigrum* very closely.

Coloration generally remarkably similar to that of a specimen marked *Macrogomphus quadratus* in the British Museum.

A single male from forests at the foot of Gunong Inas. This fine species differs from other members of the genus *Gomphidia* in having its wings of equal length with the abdomen. It appears, moreover, to be the largest known member of the legion *Lindenia*. The internal nervule of the pterostigma can hardly be said to be prolonged, but this character is scarcely of sufficient importance to justify the removal of this species from the genus *Gomphidia*. The form of the anal appendages and the absence of any leaf-like dilatation of the sides of segments 7 or 8, as well as the shape of the vertex, indicate that it must be referred to this genus, of which it may form a new section.

Legion Gomphoides.

Sieboldius grandis Krüger. (Plate VI. figs. 3, 3*a*, 4.)

Sieboldius grandis, Krüger, Stett. ent. Zeit. 1898, p. 311.

I refer to Krüger's species a fine male, which agrees in size, wing-characters, and coloration fairly closely with the females described by him from Sumatra.

Total length	83 mm.
Length of abdomen (without appendages)	59 ,,
Length of appendages (upper pair).	2 ,,
Fore wing, length	55 ,,
,, breadth	12 ,,
Hind wing, length	52 ,,
,, breadth	15 ,,
Pterostigma	5·5 ,,
Femur of last pair of legs	20 ,,
Tibia ,, ,,	14 ,,
Breadth of head	11 ,,

Antenodal cells of fore wing 22-23, postnodal 18-19; of hind wing 16-17 and 17 respectively. Pterostigma lies over six cells. Basal subcostal nerve present in all wings. Triangles of all four wings with one cross nervure. The middle thirds of all the wings

have, when looked at obliquely, a very faint whitish "smoky" appearance.

Head small, black save for a yellow transverse band on the 'frons' before the eyes, stopping abruptly at its anterior edge. Eyes distant. Occiput with the two convexities at its hinder margin more pronounced than in *S. japonicus*.

Prothorax black; at its hinder margin a transverse yellow band tapering laterally. In front of this is a yellow spot.

The colouring of the *thorax* is just as described by Krüger for the female. On the upperside a yellow band runs from the front margin up to the yellow marking in between the wings; this band is twice as broad in front end as it is at its hinder end. On either side are two fairly broad yellow oblique bands.

The *abdomen* is ringed with black and yellow; the first segment is yellow with a black mark on either side. These black marks are continued on to the second segment, in which they run a little obliquely up to the dorsal surface, meeting at the hinder end of the segment; a fine black ring runs round its posterior margin. This segment is black below, and the auricles are tipped with black continuous with the lateral stripes. The yellow ring of segments 3–8 occupies the following portion of each segment: the front two-fifths of 3, the front one-third of 4, 5, one-fourth of 6, 7, two fifths of 8; 9 and 10 are entirely black. There is a very fine mid-dorsal black line in 3; this is present, increasing in breadth as one passes back from 4–7, but absent in 8. The appendages of the tenth segment agree very closely with those figured by de Selys for *S. japonicus* (Selys, Mon. Gomph. pl. xiii. fig. 3 *b*). The upper pair are rather shorter than the tenth segment, slightly ciliated except at their end, which is sharply pointed and curved upwards; they carry two teeth on their lower side, one at about a third of their length rather blunt, directed downwards and a little outwards, the other at the end of the second third, sharper and curved backwards. The lower pair about half the length of the upper pair, thick and blunt.

The femurs of each leg have a number of short prickly spines on their outer lateral face; the hinder pair have a few delicate hairs on their upper surface. All have short tooth-like spines in regular rows along their lower sides.

A single specimen (♂) was caught at the foot of Gunong Inas (about 1000 feet above sea-level) near a small jungle pool, in January 1900.

Family CALOPTERYGIDÆ.

Subfamily CALOPTERYGINÆ.

The following is a list of the Calopterygines mentioned in Kirby's Catalogue or elsewhere as known to occur in the Malay Peninsula up to 1890.—

Neurobasis chinensis Linn.
Vestalis amœna Hagen.

Euphæa impar Selys.
,, *ochracea* Selys.
Dysphæa limbata Selys.
Devadetta argyroides Selys.
Rhinocypha fenestrella Selys.
,, *biforata* Selys.
,, *petiolata* Selys.
Micromerus aurantiacus Selys.
,, *stigmatizans* Selys.
,, *hyalinus* Selys.

Since that date Dohrn has added the following to the list:—

Micromerus lineatus Selys.
,, *signatus* Krüger.

Our collection contains examples of the species enumerated below:—

**Echo modesta* ♀, sp. n.
**Climacobasis lugens* ♂, sp. n.
Neurobasis chinensis ♂ ♀.
Vestalis amœna ♂ ♀.
Euphæa impar ♂.
,, *ochracea* ♂ ♀.
Dysphæa limbata ♂.
Rhinocypha fenestrella ♂ ♀.
,, *biforata* ♂ ♀.
* ,, *inas* ♂ ♀, sp. n.
* ,, *karschi* ♂.
**Micromerus affinis* ♂ ♀, sp. n.

[Species marked * are new to the Peninsula.]

Legion Calopteryx.

Echo modesta, sp. n. (Plate V. fig. 6.)

1 ♀, Kwala Aring.

Abdomen, length 41 mm. Hind wing, length 37·5 mm.

Fore wing with 33–36 antenodals, circ. 45 postnodals: hind wing, 32 antenodals and circ. 40 postnodals. Basal area with 9–10 cross nerves in fore wing, 8–9 in hind wing. Quadrilateral with 9–10 cross nerves in fore wing, 7 in hind wing.

Head. Mouth-parts black; antennæ black, second joint long and thick, third joint longer but much thinner. Rhinarium black, nasus bright metallic green, rest of the head very dark bronze-green.

Prothorax dark bronze-green. Thorax the same colour, rather brighter at the sides; underparts brown; legs of the same colour, but the femurs have some irregular black marks on their upper sides; hairs very long and numerous.

Wings hyaline, with a faint brownish tinge at their outer extremities. Pterostigma rather longer than broad, pale brown,

lying over 4–6 cells. Behind the pterostigma are first two rows of cells, then, after about five cells, only one row.

Abdomen dark brown, with a green iridescence in some lights on the first three and last three segments. Tenth segment very short, not half as long as the ninth, ninth longer than the eighth. Appendages shorter than the tenth, black, conical, and sharply pointed.

This species differs from *E. uniformis* Selys (? = *E. tricolor* Kruger) in having a smaller number of postnodal cells (it possesses 45 as against 60–65), in its rather smaller size, and in the colouring of the wings, which are described by Krüger as being in the female yellow all over, especially at the base and anterior margin, whereas in *E. modesta* the base of the wings is perfectly transparent (Krüger, Stett. ent. Zeit. 1893, p. 72; Selys, Bull. Ac. Belg. (2) xlvii. p. 357, id. Ann. Soc. Ent. Belg.).

There is a female in the British Museum from Mr. Ridley, collected in Penang, belonging to this species. It has 37 antenodals and 48 postnodals in the fore wings. Its abdomen is of a dull dark red-brown colour.

CLIMACOBASIS, gen. nov.

Basal area of wings reticulated. Pterostigma long; quadrilateral long, rectangular; arculus bent, sectors starting at the same point just below its middle. Principal and subnodal sectors rise at about the same level from the reticulum, between the upper sector of the arculus and the median nerve.

The nervule closing the lower basal cell runs from the lower sector of the arculus straight down to the lower extremity of the lower basal cell.

CLIMACOBASIS LUGENS, sp. n. (Plate VI. fig. 5.)

(Last three segments of the abdomen missing.)

Length of abdomen (segments 1–7) 42 mm. Length of hind wing 47 mm. Breadth of hind wing 10 mm.

Fore wing with 37 antenodals, 45 postnodal nerves. Pterostigma covering 8–9 cells, about 2·5 mm. in length, very black. Basal area with 8 cross nerves.

Hind wing. 34 antenodals, 37 postnodals. Pterostigma as in fore wing, basal area with 8 cross nerves.

Head. Lower lip, base of the mandibles, and upper lip black. Between the eyes, running forward as far as the epistome, is a remarkable square milky-white patch of considerable size, taking up in fact the greater part of the vertex. Along its hinder margin it is notched in the middle by the anterior ocellus, which is surrounded by a very small black ring which is continuous with a rectangular black patch, in which lie the two posterior ocelli; the rest of the head is of a very dark bronze-green colour.

Prothorax dark green, almost black.

Thorax. Dark metallic green above, with all the sutures and

the interalar space black; under surface and legs sooty black with long hairs. Wings hyaline. Legs brownish black, with very long hairs.

Abdomen (first 7 segments only) dull brownish black.

There can be, I think, no doubt that this species has as its nearest known ally *Archineura*. I believe, however, the differences between them are of generic rank, the chief of these being the much smaller number of accessory nervures running to the hinder margin of the wings, the mode of origin of the principal and subnodal sectors, and the character of the nerve running to the lower basal cell.

The only specimen taken has unfortunately been rather badly knocked about and has lost the last segments of the abdomen. It was caught in September in jungle at Kwala Aring. Its habits were similar to those of *Vestalis amœna*, for which at first I mistook it.

Foerster, in discussing the affinities of the genus *Matronoides*, has proposed the following arrangement of the genera belonging to the legion *Calopteryx* (Foerster, Ann. Soc. Ent. Belg. p. 66, 1899): –

- Basalar space free
  - No pterostigma
    - *Sylphis.*
    - *Calopteryx.*
    - *Phaon.*
    - *Vestalis.*
  - Pterostigma present
    - *Umma.*
    - *Sapho.*
    - *Mnais.*
    - *Psolodesmus.*
- Basilar space with cross nervules.
  - No pterostigma . . *Neurobasis.*
    - *Matrona*
    - *Matronoides.*
    - *Neurobasis.*
  - A pterostigma present.
    - *Echo.*
    - *Archineura.*

If this grouping be accepted, and it is very convenient, the last division may now stand as follows:—

- Pterostigma present.
  - Short rhomboidal pterostigma. *Echo.*
  - Pterostigma at least three times as long as broad.
    - *Archineura.*
    - *Climacobasis.*

Neurobasis chinensis (Linn.).

Neurobasis chinensis, Kirby, Cat. Odonata, p. 102; Selys, Odon. de Sumatra, Ann. Mus. Genova (2) vii. p. 189; Selys, Odon. de Birmanie, loc. cit. (2) x. 1890–1, p. 487; Selys, *Neurobasis chinensis* et ses races locales, Ann. Soc. Ent. Belg. 1896; Karsch, Ent. Nachr. xvii. no. 16, p. 243.

Five males, three females, from the Aring River in Kelantan.

This species appears to travel further down the rivers than any other Calopterygine, at least so far as my observations went. It is very widely spread in Tropical Asia.

VESTALIS AMŒNA Hagen.

Vestalis amæna, Kirby, Cat. Odonata, p. 103; Karsch, Ent. Nachr. xvii. 1891, no. 16, p. 242; Krüger, Stett. ent. Zeit. 1898, p. 75.

Several males and females from Kwala Aring and from the foot of Gunong Inas.

This species occurs also in Borneo, Java, and Sumatra.

Note.—Two females from Kwala Aring differ rather markedly from the rest of our specimens. The general colour of the body is dark bronze-green rather than emerald-green of the other specimens. Further, the wings have a distinct brownish tinge. In respect to the markings on the head, the yellow is brighter than in the other specimen. One male shows a tendency to have the wings tinged and is also of a more bronze-green shade than the other males. These three specimens are perhaps much more adult than the others.

Legion EUPHÆA.

Genus EUPHÆA Ramb.

Euphæa Ramb. Ins. Névr. p. 228 (1842); Selys, Syn. Cat., Bull. Ac. Belg. 1853, p. 50; id. Mon. Cal., l. c. 1854, p. 167.

Pseudophæa Kirby, Cat. Odonata, p. 109.

Euphæa Selys, Ann. Soc. Ent. Belg. p. 338 (1891).

EUPHÆA IMPAR Selys.

Pseudophæa impar, Kirby, Cat. Odonata, p. 109.

Four males from the Aring River above Kwala Aring.

This species differs greatly from the following, not merely in the colouring of the wing but also in the wings being much broader proportionately and with very rounded tips.

EUPHÆA OCHRACEA Selys.

Pseudophæa ochracea, Kirby, Cat. Odonata, p. 109.

Euphæa ochracea, Selys, Ann. Mus. Genova, (2) x. p. 489.

Four ♂, one ♀ two males from the Aring River in Kelantan, the other three individuals from the Selama River at the foot of Gunong Inas.

The male is a very beautiful insect, and when alive his wings seem to be almost crimson in colour as he hovers over the surface of the stream. The wings of the female specimen have hardly a trace of yellow tinge (*cf.* Selys, *loc. cit.*), and the pterostigma is brown, those of the wings of the male being rich velvety black. The rich red markings of the thorax of the male are dull brown in the female, and the whole body is duller.

	♂.	♀.
Length of abdomen without appendages..............	36 mm.	30 mm.
Length of hind wing........	29 ,,	29 ,,
,, ,, fore wing	31 ,,	30·5 ,,

Known also from Burmah and Borneo.

DYSPHÆA LIMBATA Selys.

Dysphæa limbata, Kirby, Cat. Odonata, p. 110.

Seven males from the Aring River some way above Kwala Aring. Known also from Borneo.

This species is regarded by Selys as a local race of *D. dimidiata* Selys, described from Borneo. In all my specimens the black mark at the base of the fore wing extends just beyond the level of the nodus and its margin is straight, at right angles to the anterior margin of the wing. On the hinder wing the black basal mark reaches halfway between the nodus and pterostigma and its outer margin slopes inwards a little.

Selys has remarked on the scarcity of the females of this group (Bull. Ac. Belg. (2) xxxv. p. 487). From my own experience I am sure that this scarcity in collections is not due to their being overlooked by collectors. I can safely say that I never saw a female of this species or of *Euphæa impar*, whilst the males were at times abundant.

Legion LIBELLAGO.

RHINOCYPHA FENESTRELLA Ramb.

Rhinocypha fenestrella, Kirby, Cat. Odonata, p. 113; Selys, Ann. Mus. Genov. (2) p. 491 (1891).

This species, which is closely allied to *R. quadrimaculata* of India and *R. spuria* of the Khasia Hills, ranges from Burmah as far south as Penang. It is fairly common on the Kelantan River, and Mr. Evans took some specimens in Patalung. There are two specimens in the British Museum from Province Wellesley, taken by Mr. Ridley.

RHINOCYPHA BIFORATA Selys.

Rhinocypha biforata, Kirby, Cat. Odonata, p. 113.

This species occurs rather more abundantly than the last on the Kelantan River. I also found it fairly common near the foot of Gunong Inas.

RHINOCYPHA INAS, sp. n. (Plate VI. fig. 6.)

Length of abdomen ♂ 19 mm. Length of hind wing ♂ 23 mm. Length of abdomen ♀ 18 mm. Length of hind wing ♀ 24 mm.

♂. Black. *Head* with five yellow spots, two in front on either side of the ocelli, three in a transverse row behind these, the median spot transversely elongated.

Prothorax with two small anterior and two larger lateral blue marks. Posterior lobe orange with black margin.

Thorax with a short blue mesothoracic triangle rose-colour, on either side of this lies a blue triangular humeral mark not extending higher than the apex of the mesothoracic triangle. Sides of thorax blue with two black marks on either side, the anterior running from below the first pair of wings does not extend all the way down to the legs. The second stripe, which is

broader above, runs from below the hinder pair of wings to behind the third pair of legs. The blue sides are margined postero-ventrally with a black line. Lower surface black, with two broad blue marks behind the legs.

Abdomen black. Segments 1–9 with triangular blue spots on either side, their bases resting on the hinder margin of each segment. Those in 2 3 extend the whole length of their segments, that in 4 for half the length of that segment, the rest are small.

Anal appendages black. Legs black. The two hinder pairs of femurs and tibias are white on their inner surface.

Wings tinged with yellow, blackish in the costal area from the fifth postnodal cross nerve; from about three-fifths the distance between the nodus and the black pterostigma the apical portion of the fore wing is purplish brown to the tip, except along its lower margin, where it is dusky grey shot with iridescent green. The purple mark commences suddenly and its inner margin slopes outwards from in front.

The outer half of the lower wing is also marked with brownish purple, the extreme apex and the posterior margin excepted, these are greyish brown. The inner border of the purple mark is straight, and the mark is crossed by two rows of iridescent hyaline spots. The inner row consists of three spots. The upper of these, consisting of one row of cells, lies above the nodal sector; the second, consisting first of one and later of two rows, lies between the subnodal and median sector; and the third, above the upper sector of the triangle, consists of a single row of cells. The upper spot is nearest to the base of the wings, the lowest is furthest from the base.

The first row lies at a level of about half of the distance between the nodus and pterostigma. The second row consists also of three spots. The upper is the largest and its distal end just overlaps the pterostigma. It consists of two, followed by three or four rows of cells, and is placed in series with the upper spot of the first row. The lowest spot of the outer series is placed serially with the middle spot of the inner series, whilst the middle spot of the outer series, consisting of a single row of cells, lies between the two others.

There is also a hyaline spot just at the middle of the hind wing consisting of a single row of cells, this impinges on the inner margin of the brown spot.

♀. *Head* as in the male, with the following additional marks yellow :— four spots on the dorsal surface of the 'snout' and the second joint of the antennæ, the upper half of the epistome. The genæ are marked with greenish blue in the male and yellow in the female. Prothorax black, with lateral yellow and a fine mid-dorsal yellow spot.

Thorax black, mesothoracic carina orange; a fine orange line running to the base of the first pair of wings between the carina and the humeral suture on either side, this latter is also yellow;

under surface yellow, the yellow extends for a short way on to the sides. *Abdomen* black, mid-dorsal carina orange, a yellow spot on either side of first segment. Segments 2-4 have on either side a yellow line followed by a yellow dot. Wings hyaline.

Antenodals 11 14.

This species is closely allied to *R. perforata*, but differs from that species and its other allies in the greater extent of the purple mark on the fore wings of the male. The marks of the hind wing resemble most closely those of *R. whiteheadi* Kirby.

Seven males, four females, Gunong Inas.

RHINOCYPHA KARSCHI Krüger. Stett. ent. Zeit. 1898, p. 33.

Three males from the Aring River near Kwala Aring.

Abdomen, length without appendages	14·15	mm.
Hind wings	20	,,

A single row of postcostal cells. Fore wings yellowish hyaline, hind wings with a blackish-brown mark covering their outer extremities starting about halfway between the nodus and pterostigma, its inner margin convex. No vitreous spots on the wings. The abdomen has on its dorsal side a brick red spot on segments 2–6; that on segment 2 is small and oval, from 3 6 the spots are large and rectangular, the sides of the rectangle are longer than the ends. On segment 7 are two long red lines divided by a fine mid-dorsal black line, and on segment 8 two very small red spots similarly divided. In one case the spot on segment 6 is also divided by a black line. The sides of segments 1 8 have each a yellow comma-shaped mark.

Krüger points out that this species belongs to a group intermediate in character between *R. heterostigma* and *R. tincta* of de Selys. Described by Krüger from specimens from Sumatra.

MICROMERUS AFFINIS, sp. n. (Plate VI. fig. 7.)

Two males, one female, Kwala Aring.

♂. *Head* black, rhinarium dark metallic blue. A small reddish-yellow spot on either side of the ocelli, behind these three others of the same colour, viz. a transversely elongated median spot on the top of the occiput and two lateral spots.

Prothorax black, with two small lateral spots, two anterior dorsal spots, and a single posterior dorsal spot of the same yellow colour as the head-spots. There is also a fine yellow line running along the dorsal posterior margin, ending laterally in a spot of the same colour just above the base of the first pair of legs.

Thorax black, a small antehumeral stripe on either side not reaching to the top of the mesothorax, and a fine line on the upper half of the humeral suture also yellow. At the sides are two large oblique yellow bars; the anterior of these is divided into two halves by a black mark projecting into it from its hinder

margin. In the upper half is a large black spot, and at the bottom of the lower half is a smaller spot also black.

Wings hyaline. Outer two-sevenths of fore wings (which are without pterostigma) opaque dark brown. Five antenodals (six in one case). Lower wings with a slight brownish opacity at the margin. Postnodals 11-13.

Length of hind wing 17 mm.

Abdomen black, with the following yellow marks:—On segments 2-6 a dorsal spot divided longitudinally into two by the mid-dorsal black carina. On segments 4-5 these marks have an anterior lateral prolongation, giving them the appearance of two figure 7's lying back to back; in segment 6 the lower limb of the 7, so to speak, has disappeared, leaving merely two anterior marginal lines. A large lateral spot on segment 1. On either side of segments 2-3 are two spots in the form of a !, the 'dash' being anterior. On 4-5 only the 'dash' is present and is very small on 5. Anal appendages black, upper pair two-thirds length of the 9th segment.

♀. *Head* as in the male, with black less velvety, yellow marks lighter, and the following additional yellow markings:- Basal parts of lower lip and of labrum, epistome with a yellow spot on either side. Frons with four spots arranged in the form of a square, the anterior pair larger than the posterior. Genal region yellow.

Prothorax and *thorax* as in the male, but the thorax has a median dorsal yellow stripe. *Abdomen* dull black, with a fine mid-dorsal yellowish line on each segment, not continuous at the margins from segments 2-9. In 9 it occupies only the posterior half of the segment. Segments 1-9 each with a conspicuous lateral yellow mark running nearly the whole length of the segment, narrowest at the middle except in 9, where it is reduced to a spot at the hind end of the segment, which is larger than the eighth, as large as the seventh. Tenth very small. Length of abdomen 13 mm.

Wings hyaline, pterostigmata pale brown. Length of hind wing 19 mm.

Differs from *M. semiopacus* in having the apex of the hinder wing opaque, in the possession of markings on the head, and in the spots on segment 6 of the abdomen. The brown mark of the front wings is also rather less extensive, 5¼ mm.; 6 in *M. semiopacus*. From *M. martinæ* Karsch it differs in having only three yellow spots at the back of the head, in the markings at the sides of the thorax, and in having the dorsal abdominal markings broader in front; also in the rather smaller number of antenodal nerves on the fore wing.

Description of a new Species of the Genus Lestes.

LESTES RIDLEYI, sp. n.

♂. Length of abdomen (without appendages) 48 mm., of hind wing 31 mm., pterostigma 2·75 to 3 mm.

General colour dull bronze-green. *Wings* hyaline, iridescent, slightly tinged with brown at the tip. Two supplementary sectors between the subnodal and median sector, 18–19 post-nodals. The nodal sector begins in the seventh cell after the nodus in the fore wings, and in the sixth in the hind wings. Reticulation and pterostigma black.

Head. Lower lip dull yellowish brown, upper lip brown, rest of the upper part of the head bronze-coloured.

Prothorax dull brown, with a small bronze transverse mark along its posterior margin, which is not indented.

Thorax. Upper surface dark bronze-green, with an obscure paler line following the humeral suture. Sides and lower surface yellowish brown.

Abdomen. First segment yellowish brown. The segments 2–7 have a roughened dorsal surface, which is brown-green with a fine yellowish-green basal ring; ventral surface bluish green, the bronze extends laterally; segments 8–10 smooth, bluish, pruinose. Anal appendages lost, but, if I remember rightly, these were also of a bluish colour.

The male was taken in the same locality as the specimen of *Pericnemis*, at the foot of Gunong Inas. There is stated to be a female belonging to the same species, which I have not examined, in the British Museum collection, taken by Mr. Ridley in Singapore.

L. ridleyi is closely allied to *L. orientalis* Hagen, from Ceylon, and *L. udeana* Krüger, from Sumatra. It is sufficiently distinguished from both by its size, being intermediate in this respect.

EXPLANATION OF THE PLATES.

PLATE V.

Fig. 1. ***Neurocena ida*** ♀, p. 72.
2. ***Onychothemis testacea*** ♂, p. 75.
3. ***Tetrathemis pulchra*** ♂, p. 71.
4. ***Idionyx dohrni*** ♀, p. 78.
5. ***Gomphus consobrinus*** ♂, p. 80.
6. ***Echo modesta*** ♀, p. 84.

PLATE VI.

Fig. 1. ***Gomphidia perakensis*** ♂, p. 81.
2. End of abdomen of ditto.
3. ***Sieboldius grandis*** ♂, p. 82.
3*a*. End of abdomen of ditto.
4. Side view of thorax of ditto (× 1½).
5. ***Climacobasis lugens***, fore wing, p. 85.
6. ***Rhinocypha inas*** ♂, p. 88.
7. ***Micromerus affinis*** ♂ (× 1½), p. 90.

3. List of a small Collection of Orthopterous Insects formed by Sir Harry Johnston in British East Africa and Uganda in 1899 and 1900, with Descriptions of Five new Species. By W. F. KIRBY, F.L.S., F.E.S., Assistant in the Zoological Department, British Museum (Natural History), South Kensington.

[Received November 28, 1901.]

The total number of species of Orthopterous Insects represented in the collection is 27, of which 23 are enumerated in the present paper, four species, probably new, remaining over for future consideration.

BLATTIDÆ.

BLATTINÆ.

DEROPELTIS.

Deropeltis Burm. Handb. Ent. ii. p. 486 (1838).

1. DEROPELTIS MELANOPHILA.

Ischnoptera melanophila Walk. Cat. Blatt., Suppl. p. 146 (1869).

One male, from Baringo, 4000 feet, Dec. 20, 1899.

This species was described by Walker from Zanzibar. There are also specimens in the Natural History Museum from Samburu, British East Africa, from Mr. C. S. Betton's collection, and from Mombasa and Madagascar. This species differs from *D. erythrocephala* Fabr. by the black head, with only a streak within the antennæ, and the lower mouth-parts red.

POLYPHAGINÆ.

POLYPHAGA.

Polyphaga Brullé, Hist. Nat. Ins. ix. p. 57 (1835).
Heterogamia Burm. Handb. Ent. ii. p. 488 (1838).

2. POLYPHAGA ÆGYPTIACA.

Blatta ægyptiaca Linn. Syst. Nat. (ed. x.) p. 424. n. 2 (1758).

One female specimen, Baringo, 4000 feet, Dec. 20, 1899.

Widely distributed in Africa and Southern Europe.

MANTIDÆ.

MANTINÆ.

TENODERA.

Tenodera Burm. Handb. Ent. ii. p. 534 (1838).

3. TENODERA CAPITATA.

Tenodera capitata Sauss. Mitth. Schweiz. ent. Ges. iii. p. 69 (1869); Mém. Soc. Genève, xxi. p. 293 (1871).

Mount Ruwenzori; a large specimen measuring 5¼ inches in expanse.

This species inhabits East and Central Africa and the Congo district.

VATINÆ.

POPA.

Popa Stål, Œfv. Vet.-Akad. Förh. xiii. p. 169 (1856).

4. POPA UNDATA.

Mantis undata Fabr. Ent. Syst. ii. p. 19 (1793).

Mount Elgon; one specimen.

A well-known species in South Africa and Madagascar.

ACHETIDÆ.

CURTILLINÆ.

CURTILLA.

Gryllotalpa Latr. Hist. Nat. Crust. Ins. xii. p. 121 (1804), *nom. spec.*

Curtilla Oken, Lehrb. Nat. iii. p. 445 (1815).

5. CURTILLA AFRICANA.

Gryllotalpa africana Beauv. Ins. Afr. Amér. p. 229, pl. 2. f. 6 (1805).

Two specimens, 4000 feet, Baringo, Dec. 20, 1899.

A widely-distributed African and East-Indian species.

ACHETINÆ.

ACHETA.

Gryllus (*Acheta*) Linn. Syst. Nat. (ed. x.) i. p. 428 (1758).

Acheta Leach, Edinb. Encycl. ix. p. 119 (1815).

6. ACHETA BIMACULATA.

Gryllus bimaculatus De Geer, Mém. Ins. iii. p. 338, pl. 43. f. 1 (1773).

Acheta capensis Fabr. Syst. Ent. p. 281. n. 6 (1775).

Four specimens, Entebbe, Oct. 1900.

A common species throughout a great part of Southern Europe and Asia, and throughout all Africa.

PHASGONURIDÆ.

MECOPODINÆ.

ANŒDOPODA.

Anœdopoda Karsch, Berl. ent. Zeitschr. xxxvi. pp. 333, 346 (1891).

7. ANŒDOPODA LATIPENNIS.

Mecopoda latipennis Burm. Handb. Ent. ii. p. 686. n. 2 (1838).

Two specimens taken between Lake Victoria and Lake Tanganyika.

A common species in both East and West Africa.

Hetrodinæ.

Enyaliopsis.

Enyaliopsis Karsch, Berl. ent. Zeitschr. xxxi. p. 60 (1887).

8. Enyaliopsis petersii.

Hetrodes petersii Schaum, Ber. Akad. Berl. 1853, p. 777; Peters's Reise Mossamb., Zool. v. p 119, pl. vii. f. 7 (1862).

Three specimens, from Mounts Elgon and Ruwenzori.

A common species throughout East Africa.

Locustidæ.

Tryxalinæ.

Acrida.

Gryllus (*Acrida*) Linn. Syst. Nat. (ed. x.) i. p. 427 (1758).

9. Acrida acuminata.

Acrida acuminata Stål, Rec. Orth. p. 97 (1873).

Baringo, 4000 feet, Dec. 20, 1899.

Described from "Caffraria." Three old specimens in the Natural History Museum are from the "Cape of Good Hope."

Phlœoba.

Phlœoba Stål, Eugenie's Resa, p. 340 (1862).

10. Phlœoba rufescens, sp. n.

Male. Long. corp. 14 mm.; long. tegm. 9 mm.

Female. Long. corp. 21 mm.; long. tegm. 17 mm.

Rufo-testaceous, antennæ about 20-jointed, brown, except towards the base, subensiform, broadest for about six of the first joints of the flagellum and gradually tapering to the extremity; head above with two obsolete reddish lines, marked with a few black specks, diverging behind and continued still more indistinctly on the pronotum. Pronotum at least twice as long as broad; carinæ pale yellow, the lateral ones edged below with a black or reddish line: head with one or two indistinct reddish (or, in the male, blackish) lateral stripes, continued on the sides of the pronotum; these sides distinctly scabrous in the female, and marked towards the front below the lateral carina with two large smooth pits. On the upper surface the hinder lobe of the pronotum is punctured, the rest being nearly smooth; the hind sulcus is placed behind the middle, and the two front ones are widely interrupted in the middle, and only the second continued

on the sides. Tegmina hyaline with reddish nervures; hind tibiæ rather hairy, with eleven teeth on the outer edge.

Four specimens (1 ♂, 2 ♀, 1 nymph) from Baringo, Dec. 20, 1899.

There are several closely allied species from East Africa, of which one only (*P. alternata* Schulthess, *nec* Brunner) has hitherto been described.

PNORISA.

Gomphocerus (*Pnorisa*) Stål, Eugenie's Resa, p. 341 (1860).

11. PNORISA CAPENSIS.

Stenobothrus capensis Walk. Cat. Derm. Salt. B.M. ii. p. 764. n. 62 (1870).

Fifteen specimens, Baringo, Dec. 20, 1901.

None of these specimens exactly agree with the unique type of the species, which is, besides, in rather poor condition; but they vary so much among themselves that I cannot consider them distinct. The males have indefinite longitudinal dusky markings on the head and thorax (chiefly on the sides) as in Walker's type; but the latter has the outer central area of the femora much more completely filled up with blackish than in any of the Baringo males, which have only isolated and variable blackish patches on that area, the largest towards the extremity. In the female there is a broad blackish band running backwards from the eye, over the sides of the pronotum, and a portion of the tegmina, and more or less distinctly bordered above and below by yellow lines. The central area of the hind femora is filled up externally in its upper half with a black stripe, broken into three parts, and is bordered on the upperside above by two longer and narrower black stripes.

LOCUSTINÆ.

CHLŒBORA.

Chlœbora Sauss. Mém. Soc. Genève, xxviii. (9) pp. 54, 132 (1884); xxx. (1) pp. 18, 19, 33 (1888).

12. CHLŒBORA THALASSINA, sp. n.

Exp. al. 80 mm.; long. corp. 36 mm.

Female. Rufo-testaceous; carina of the pronotum very slightly raised, subobsolete behind, hinder half set with large granules, and shorter and more rounded behind than in *Humbe tenuicornis* Schaum. Tegmina with two oblique brown bands, the first at one-quarter of the length, and the second, much narrower and less complete, about the middle, bounding the outer subhyaline area. Costal area spotted with brown, especially about the first brown band. Beyond the lower extremity of the narrow outer band a series of linear blackish marks runs along the inner margin. Wings greenish yellow (possibly bright yellow in

perfectly fresh specimens) towards the base, followed by a broad, curved black band as in *Gastrimargus marmoratus*, extending to the anal angle and nearly touching the hind margin beyond the curve; apex of the wing hyaline.

One specimen, Mount Ruwenzori.

Closely allied to *C. kelleri* Schulth., from Somali, but the pronotum is broader, less strongly arched and carinated, and more rounded behind, and the black band on the hind wings is broader and more regular.

GASTRIMARGUS.

Gastrimargus Sauss. Mém. Soc. Genève, xxviii. (9) pp. 109, 110 (1884); xxx. (1) p. 37 (1888).

13. GASTRIMARGUS MARMORATUS.

Gryllus marmoratus, var. β, Thunb. Mém. Acad. Pétersb. v. p. 232 (1815); ix. p. 410, pl. 14. f. 3 (1824).

Pachytylus (*Œdaleus*) *marmoratus* Stål, Rec. Orth. i p. 123 (1873).

Œdaleus marmoratus Sauss. Mém. Soc. Genève, xxviii. (9) p. 112, n. 2 (1884); xxx. (1) p. 39, n. 3 (1888).

One specimen of var. *africana* Sauss. (Mém. Soc. Genève, xxx. (1) p. 39) between Lakes Victoria and Tanganyika.

14. GASTRIMARGUS DETERMINATUS.

Pachytylus determinatus Walk. Cat. Derm. Salt. B.M. v. Suppl. p. 72 (1871)

Œdaleus verticalis Sauss. Mém. Soc. Genève, xxviii. (9) p. 111 (1884).

Twelve specimens, Baringo, 4000 feet.

There are specimens in the Natural History Museum from the Cape, Knysna, Natal, and Marabastaat.

PHYMATINÆ.

PHYMATEUS.

Phymateus Thunb. Mém. Acad. Pétersb. v. p. 257 (1815).

15. PHYMATEUS ÆGROTUS.

Pœcilocera ægrota Gerst. Arch. f. Nat. xxxv. p. 216 (1869).

Three discoloured specimens, taken between Lake Victoria and Lake Tanganyika.

A common species throughout East Africa.

DICTYOPHORINÆ.

TAPHRONOTA.

Taphronota Stål, Œfv. Vet.-Akad. Förh. xxix. p. 51 (1873).

16. TAPHRONOTA GABUNICA.

Taphronota gabunica Karsch, Ent. Nachr. xiv. p. 358 (1888).

M nt Ruwenzori.

Two discoloured specimens, apparently belonging to this West-African species.

DICTYOPHORUS.

Dictyophorus Thunb. Mém. Acad. Pétersb. v. p. 258 (1815).
‖ *Petasia* Serv. Ann. Sci. Nat. xxii. p. 278 (1831).

17. DICTYOPHORUS ANCHIETÆ.

Petasia anchietæ Bolivar, Jorn. Sci. Lisb. xxx. p. 110 (1882).

Three specimens from Entebbe, Oct. 1900.

Originally described from Angola, but apparently common in East Africa. There are specimens in the Natural History Museum from Abyssinia, Zomba, British East Africa, and Tanganyika.

PAMPHAGINÆ.

XIPHICERA.

Xiphicera Lamarck, Anim. sans Vert. iv. p. 243 (1817).

18. XIPHICERA GIBBA, sp. n.

Long. corp. 37 millim.; long. pron. 17 millim.; long. fem. post. 12½ millim.; lat. 5 millim.

Male. Dark red; vertex longer than broad, granulated, sloping, and projecting in a point scarcely beyond the level of the lower part of the face, to which it slopes gradually down; antennæ, funiculus apparently 6-jointed (the three basal joints hardly separable), followed by a narrower joint but broader than long, two intermediate joints, the first shorter than the other, and the flagellum, which consists of only two joints, one longer than broad, narrowed at the base and truncated at the end, and the terminal joint linear. Pronotum very high, laterally compressed, granulated, pointed in front and bifid behind; in front it slopes upwards to a rounded-off obtuse angle before the middle, and then runs backwards to the extremity almost straight, the hinder part being obtusely denticulated. Tegmina and wings rudimentary; back of abdomen with small teeth on the median line. Hind femora granulated with white, and with the upper surface straight and serrated, the extremity truncated; the lower edge moderately broadly laminated, denticulated, and with a concavity before the extremity; hind tibiæ with strong short spines, eight on the outer edge.

A single specimen from between Lake Victoria and Lake Tanganyika. It would probably have fully-developed wings, if mature.

Allied to *X. spinulosa* Saussure and *X. haploscelis* Schaum.

MESAMBRIINÆ.

Two immature specimens from Baringo (Dec. 20, 1899), probably belonging to a new genus allied to *Mesambria* Stål.

CYRTACANTHACRINÆ.

CYRTACANTHACRIS.

Cyrtacanthacris Walk. Cat. Derm. Salt. B.M. iii. p. 550 (1870).

19. CYRTACANTHACRIS PALLIDICORNIS, n. n.

Acridium ruficorne Burm. (nec Fabr.) Handb. Ent. ii. p. 630. n. 9 (1838); Stål, Rec. Orth. i. p. 60. n. 2 (1873).

Acridium succinctum Serv. (nec Linn.) Ins. Orth. p. 642 (1839).

Seven specimens, between Lake Victoria and Lake Tanganyika. There is also an immature specimen in the collection, perhaps belonging to the same species, from Ruwenzori. This insect much resembles *Acridium tataricum* Stål (nec Linn., which probably = *Schistocerca peregrina* Oliv.).

CATANTOPINÆ.

CATANTOPS.

Catantops Schaum. Monatsb. Berl. Akad. 1853, p. 779.

20. CATANTOPS CAPICOLA.

Acrydium (*Catantops*) *capicola* Stål. Eugenie's Resa, p. 331 (1860).

Catantops humeralis Stål (nec Thunb.), Rec. Orth. i. p. 69. n. 1 (1873).

Baringo, 4000 feet, Dec. 20, 1901.

A rather large specimen, measuring 48 millim. in expanse.

CALLIPTAMINÆ.

EURYPHYMUS.

Euryphymus Stål, Rec. Orth. i. p. 72 (1873).

21. EURYPHYMUS CRASSUS.

Caloptenus crassus Walk. Cat. Derm. Salt. iv. p. 694. n. 39 (1870).

C. illepidus Walk. l. c. n. 40 (1870).

Var. *C. pinguis* Walk. l. c. n. 41 (1870).

Twenty specimens from Baringo, 4000 feet, Dec. 20, 1899.

Walker's specimens are from Natal, so far as they were labelled with any special locality.

EUPREPOCNEMINÆ.

HETERACRIS.

Heteracris Walk. Cat. Derm. Salt. B. M. iv. p. 655 (1870).

Demodocus Stål, Bihang Vet.-Akad. Handl. v. (4) p. 75 (1878).

As Stål's name *Demodocus* is preoccupied in Coleoptera, I propose to restrict Walker's name *Heteracris* to this genus.

22. HETERACRIS BETTONI, sp. n.

Male. Long. corp. 31–40 millim.; long. al. ant. 14–15 millim.; long. fem. post. 16–17 millim.

Female. Long. corp. 31–40 millim.; long. al. ant. 20–34 millim.; long. fem. post. 25–33 millim.

Chestnut-red, lighter in the male than in the female; vertex much contracted between the eyes, with a shallow depression triangularly expanded on each side beyond the contraction: this is intersected by a slight carina, the continuation of the middle carina of the pronotum. Pronotum with the hinder lobe granulated; in front of this portion extends a brown shade, divided by the central carina, and narrowing in front, but filling up most of the centre of the pronotum and vertex as far as the end of the depression on the latter. Head finely punctured; sides of the pronotum more sparingly but more coarsely punctured than the hinder part, and with two very large pits below the lateral carina in front of the first suture, and behind these two others between the two sutures in the female, but only a still larger one in the male; below this, on the middle of the central lobe of the pronotum, is an oblong yellow carina. Legs red, first and second pairs short, hind legs very long, femora with the basal half moderately thickened; tibiæ about as long as the femora, with from twelve to fourteen spines, slightly black-tipped, and gradually increasing in length from the base to the extremity. First and third joints of tarsi of about equal length, the first thickened in the middle, especially beneath; the second about three-fifths as long. Tegmina brownish hyaline, with dark nervures and the outlines of several large spots; some of the longitudinal nervures and intermediate spaces are reddish, especially above and below the central area; in closed specimens the lower red stripe is seen to be continuous with the red borders of the pronotum. Wings clear hyaline, with brown and reddish nervures.

Described from three males and one female from Baringo (*Johnston*); one female from Maungu, B. E. Africa (*Betton*); one female from Thika-Thika, B. E. Africa (*Gregory*); one female from Mombasa (*Dr. J. Wilson*); one female from Atbara, Abyssinia (*purchased*).

The female from Baringo is smaller than any of the others.

Apparently allied to *Heteracris speciosa* Walk. from Sierra Leone, of which the Museum at present possesses only the type, an immature specimen.

CALOPTENOPSIS.

Caloptenopsis Bolivar, Jorn. Sci. Lisb. (2) i. p. 173 (1889).

Head with the vertex between the eyes narrowed and tricarinate, the carinæ very short, and formed by an oblong fovea on each side of the central carina; beyond this point the vertex slopes smoothly into the broad frontal ridge, which is not sulcated but sparingly punctured, and is nearly straight. Thorax broad, tricarinate, depressed, with the central carina higher than

the others; principal suture straight, a little in front of the middle; second suture curved backwards above and diverging from the hinder one on the sides; front suture scarcely continued on the sides, but there is a lateral suture near the front of the pleura, curving backwards below. Pectoral tubercle large and thick, obtusely rounded, broader than long. Pleura long, projecting a little on the middle edge below, and rounded. Hind femora thick, not much narrowed towards the extremity and denticulated above. Hind tibiæ with six outer and eight inner spines, and provided with five terminal spines, the middle one inferior, as long as the metatarsus, hairy, with a strong tooth on the upper surface before the extremity. Metatarsus trilobate beneath; second joint short above, but with a projection below the base of the terminal joint; the latter is slender, with large claws and pulvillus, and a little shorter than the metatarsus. Male with the cerci very broad, somewhat spatulate at the extremity, and furnished with a short black terminal tooth on the outer side. Female with the upper appendages longer than the lower ones and hooked upwards at the extremity; the lower appendages hooked downwards.

A remarkable and interesting genus, which I had characterized as new before recognizing its identity with *Caloptenopsis*; and as my definition was already in print, I have allowed it to stand. My definition, of course, is taken from *C. johnstoni*.

There are now several species of *Caloptenopsis* known, chiefly from East and Central Africa.

23. CALOPTENOPSIS JOHNSTONI, sp. n.

Long. corp ♂ 17, ♀ 21 millim.; exp. al. ♂ 25, ♀ 40 millim.

Rufo-testaceous; face not carinated, clypeus broad below, with a black spot at each lower angle. Pronotum varied with blackish in the middle above, especially in front; the inner borders of the lateral carinæ closely punctured; the hinder lobe and the metapleura thickly and closely punctured. Front of the pleura, below the lateral carinæ, with two large pits, the first double, below these is a brown curved band, ceasing at the hinder suture; below it is a second but shorter brown stripe. The colour of the pleura is paler than the upper part of the pronotum. Subalary spaces with large punctures. Both surfaces of the hind femora with curved or slightly angulated black lines, followed by black dots on the carinæ; the spaces between the outer and middle carinæ above and between the three lower carinæ unspotted. Upper curve of the knees black on both sides, space below this yellowish. Tibial spines rather small and tipped with black. Wings brownish hyaline, interspersed with brown network-patterns in the middle, becoming more macular towards the extremity; anal area with reddish nervures.

Described from three males and four females from Baringo, Dec. 20, 1899.

February 18, 1902.

Prof. G. B. Howes, LL.D., F.R.S., Vice-President, in the Chair.

Mr. L. W. Byrne, F.Z.S., called the attention of the Meeting to the description of *Lepidogaster stictopteryx*, a supposed new species of Sucker-fish, which had been given by Mr. E. W. L. Holt and himself in a communication made to the Society on November 15th, 1898, and made the following remarks:—

On November 15th, 1898, we exhibited before this Society (P. Z. S. 1898, p. 589) specimens of a *Lepidogaster*. We supposed them to be attributable to a new species, for which we suggested the name of *L. stictopteryx*.

The examination of further specimens has convinced us that we have been guilty of adding further confusion to the synonymy of the species of this genus, and that our *L. stictopteryx* is not specifically distinct from *L. microcephalus* Brook, the synonymy of which should stand as follows:—

Lepidogaster microcephalus.

L. microcephalus Brook, Proc. Roy. Phys. Soc. Edin. x. p. 166, pl. vii. (1888).

? *L. bimaculatus* ♂. Guitel, Comptes Rendus, cxl. p. 759 (1890).

L. stictopteryx Holt & Byrne, P. Z. S. 1898, p. 589.

Fortunately our friend Professor Guitel, of Rennes, is continuing his studies upon this genus, and informs us that he has obtained at Roscoff material which he believes will enable him to deal with the question in a satisfactory manner. Under these circumstances we feel it would be superfluous for us to do more than correct our own mistake, and we have entrusted our notes, drawings, and material to his most able hands.

Mr. W. B. Tegetmeier, F.Z.S., exhibited and made remarks upon the skull of a supposed hybrid between the Sheep and the Pig, named "Cuino"[1] by the inhabitants of Mexico, where it was extensively reared as an agricultural animal. The skull was clearly that of a Pig.

Dr. C. I. Forsyth Major, F.Z.S., exhibited some jaws and teeth of Pliocene Voles (*Mimomys*, gen. nov.), from the Norwich Crag at Thorpe, and from the Upper Val d'Arno; and made the following remarks:—

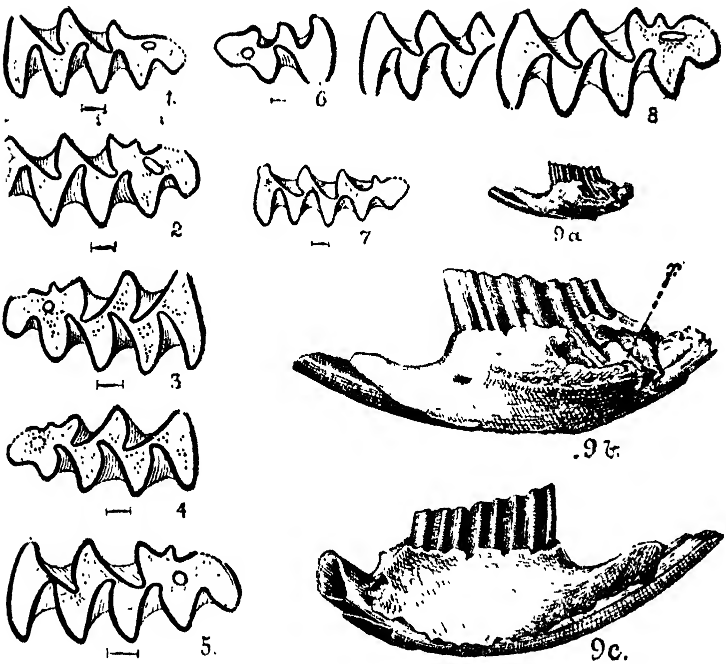
The Pliocene remains of Voles here exhibited—a mandibular ramus from the lacustrine beds of the Upper Val d'Arno in Italy, and over forty bits from the Norwich Crag at Thorpe,

[1] For information respecting this supposed hybrid see 'Field,' vol. xcvi. (1900) p. 497, and xcvii. (1901) p. 233.

mostly isolated teeth—are so minute and fragmentary, that I have to supplement my demonstration by sketches.

The jaw from the Val d'Arno (text-fig. 13, nos. 8, 9), containing two anterior rooted molars, was mentioned by me upwards of twenty years ago. The first lower molar (text-fig. 13, no. 8) exhibits in its anterior portion an enamel islet, which is a very strange feature in a Vole's molar. I am sorry to trouble members with such a minute detail; but almost the whole interest centres around this insular eccentricity, so to

Text-fig. 13.



H. G. del.

Teeth and jaws of Tertiary Voles.

Figs. 1–5 & 7 represent the first lower molars, upper view.—Fig. 1. ***Mimomys intermedius*** (Newt.), West Runton Forest Bed (B. M. No. 6968 *d*, from Savin Coll. No. 1705): left side.—Figs. 2 & 3. ***Mimomys pliocænicus*** (Maj.), Norwich Crag, Thorpe (Norw. Castle Mus. No. 971). fig. 2, left side; fig. 3, right side.—Figs. 4 & 5. ***Mimomys pliocænicus*** (Maj.), Norwich Crag, Thorpe (Norw. Castle Mus. No. 551, from Fitch Coll.): fig. 4, right side; fig. 5, left side (figured by E. T. Newton, 'Forest Bed,' pl. 13. fig. 13).—Fig. 6. ***Mimomys pliocænicus*** (Maj.), third upper molar, left side; East Runton Forest Bed (B. M. No. 6967, from Savin Coll. No. 464).—Fig. 7. ***Mimomys newtoni***, sp. n., East Runton Forest Bed (B. M. No. 6967 *a*, from Savin Coll. No. 430): left side.—Fig. 8. ***Mimomys pliocænicus*** (Maj.), first and second lower molars, upper view; Upper Val d'Arno, Italy (Florence Museum).—Fig. 9 *a*. The same specimen, outer view of the mandible, nat. size.—Fig. 9 *b*. The same enlarged, *r*=root of m². —Fig. 9 *c*. The same mandible, inner view, enlarged.

speak, of the fossil tooth. I had before met with a similar feature in one of two very young teeth of the recent *amphibius*-group, from Pisa, which presumably belonged to Savi's *Arvicola destructor*. In the recent tooth the enamel islet showed a slightly different position and genesis, was quite superficial and therefore ephemeral; it was associated with some other complications—two additional shallow enamel-loops—which likewise approach the tooth of the very young *amphibius* to that of the Pliocene form. In the recent species this pattern is very soon worn away; there is no more trace of it in slightly older specimens. This is a fresh instance of a recent form preserving in the younger stages of its molar the features of a Tertiary form.

When during the revision of the fossil Rodentia of the British Museum, the Microtidæ of the Forest Bed came to be studied, I was anxious to ascertain whether the enamel islet occurred there too in adult specimens, as is the case in the Val d'Arno fossil.

Mr. E. T. Newton has published an elaborate description of the Rodents of the Forest Bed and Norwich Crag, and has shown that the larger Voles are, by the presence of well-developed fangs to their molars, very distinct from the *amphibius*-type with which they had been confused by all previous writers. He who enjoys the advantage of standing on his predecessor's solid shoulders, has also the duty to try and see a little farther, especially when additional material has accumulated in the meantime. If, therefore, to-day a step forward is possible in the knowledge of the Pliocene Voles, it is but fair to acknowledge that this is in a great measure due to Mr. Newton's previous work.

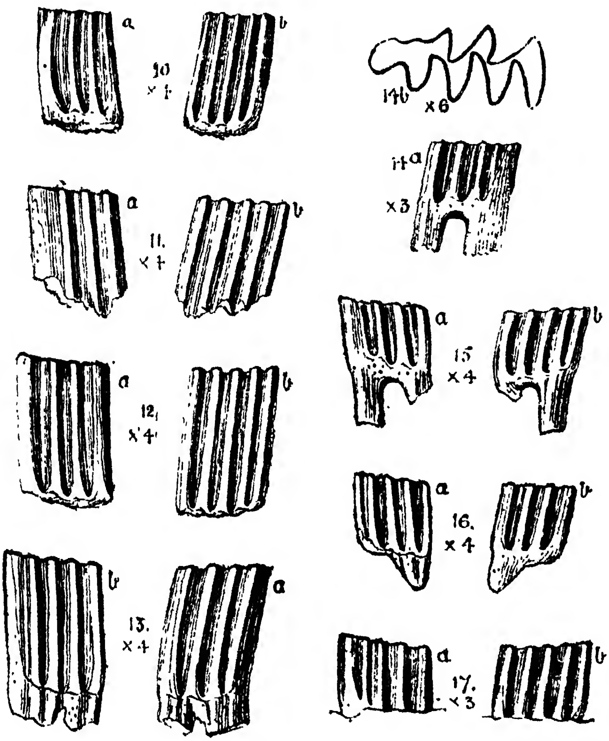
Among the Voles' teeth of the Savin Collection from the Forest Bed, I found the character alluded to, but only in a relatively small number of teeth (*e.g.* text-fig. 13, no. 1) and in different proportions according to the localities. Whilst among 55 first molars from the West Runton Upper Freshwater Beds only four showed the character in question the number of teeth provided with enamel islets was larger among the less numerous Voles' remains from the East Runton Forest Bed, and, moreover, other features became apparent.

From the Norwich Castle Museum I have received of late, through the kindness of Mr. Leney, a small number of teeth and two jaws, here exhibited, which were collected by Mr. Fitch in the Norwich Crag at Thorpe (text-figs. 13, nos. 2-5; 14, no. 15; 15, nos. 20, 29). Here the presence of the enamel islet is the rule: there are ten anterior lower molars in this small series—eight exhibit the islet, one is very old and apparently has lost every trace of it; the tenth, a very young tooth (text-fig. 15, no. 29), reveals the genesis of the islet, which is the central portion of the antero-external enamel fold. Moreover, the teeth are of two different sizes.

In short, the result of the investigation is, that the Voles of the Norwich Crag are different from those of West Runton and are represented by two species; whereas at East Runton the

West Runton type occurs together with the Crag types. The larger of the Crag-forms is besides represented by specimens from Bramerton (text-fig. 14, nos. 14 *a*, *b*) and from Kyson in Suffolk.

Text-fig. 14.

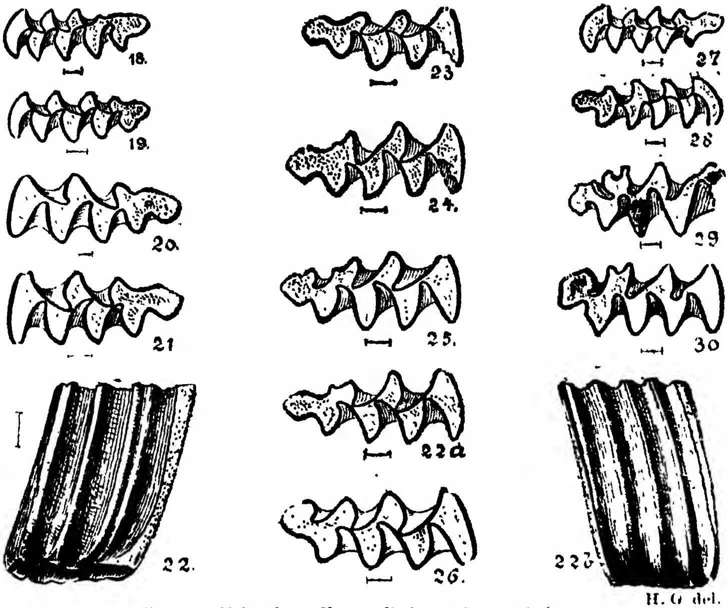


Teeth of Tertiary Voles, enlarged.

Figs. 10–17. Views of first lower molars. *a*=outer aspect, *b*=inner aspect (except 14 *b*=upper view).—Fig. 10. ***Mimomys newtoni***, sp. n., same specimen as fig. 7.—Fig. 11. ***Mimomys intermedius*** (Newt.), same specimen as fig. 1.—Fig. 12. ***Mimomys intermedius*** (Newt.), same specimen as fig. 21.—Fig. 13. "***Mimomys intermedius*** (Newt.)," same specimen as fig. 26, right side; West Runton (B. M. No. 6968 *e*, from Savin Coll. No. 1705).—Fig. 14 *a*. ***Mimomys pliocænicus*** (Maj.), Norwich Crag, Bramerton (Norwich Castle Mus. No. 728, from Reeve Coll.).—Fig. 14 *b*. The same, upper view.—Fig. 15. Same specimen as fig. 20, ***Mimomys pliocænicus*** (Maj.), Norwich Crag, Thorpe (Norwich Castle Mus. No. 971).—Fig. 16. ***Mimomys newtoni*** (?), East Runton Forest Bed (B. M. No. 6967 *b*, from Savin Coll. No. 464).—Fig. 17. ***Mimomys pliocænicus*** (Maj.), same specimen as fig. 5.

For the present I content myself with three specific names, calling (1) *pliocænicus* the larger Crag-form, which I identify with the one from the Val d'Arno; (2) *newtoni*, a smaller rooted

Text-fig. 15.



Teeth of Voles from Forest Bed and Norwich Crag.

Figs. 18–21, 22 *a*, 23–30, first lower molars, upper view, enlarged.

Fig. 18. *Microtus*, sp., recalling somewhat *M. gregalis*; rootless, left side; West Runton (B. M. No. 6987 *a*, from Savin Coll. No. 1708).—Fig. 19. *Microtus nivaloides*, sp. n., recalling *M. nivalis*, but smaller and anterior loop more produced: left side; rootless (B. M. No. 6987 *b*, from Savin Coll. No. 1708).—Fig. 20. *Mimomys pliocænicus*, same specimen as fig. 15: left side, enamel islet vanishing.—Fig. 21. *Mimomys intermedius*, same specimen as fig. 12; West Runton (B. M. No. M 6968 *a*, from Savin Coll. No. 1692): left side, cement-spaces closed below, but roots not yet developed.—Fig. 22. *Mimomys intermedius*, first lower molar, right side, outer aspect: West Runton (B. M. No. 6968 *b*, from Savin Coll. No. 1692): cement-spaces closed below, but roots not yet developed; fig. 22 *a*. Same specimen, upper view; fig. 22 *b*. Same specimen, inner aspect.—Fig. 23. *Mimomys newtoni*?, East Runton; same specimen as fig. 16.—Fig. 24. *Mimomys intermedius*, right side; East Runton (B. M. No. 6967 *c*, from Savin Coll. No. 465): cement-spaces, with the exception of the antero-external, still open below.—Fig. 25. *Mimomys intermedius*, right side, young; West Runton (B. M. No. M 6968 *c*, from Savin Coll. No. 1692): cement-spaces narrowing below, but not closed (the lower end of the tooth is incomplete from break). From an inspection of the outer side it becomes evident that by progress of wear the anterior enamel fold would soon have been reduced to an ephemeral enamel islet.—Fig. 26. *Mimomys intermedius*?, same specimen as fig. 13, right side; West Runton.—Fig. 27. *Microtus* sp., recalling *M. arvalis*: left side, rootless; West Runton (B. M. No. M 6987 *c*, from Savin Coll. No. 1708).—Fig. 28. *Microtus* (*Pitymys*) sp., right side, rootless; West Runton (B. M. No. M 6987 *d*, from Savin Coll. No. 1708). Behind the anterior loop follows a transverse loop resulting from the union of the third outer and the fourth inner prism (counting from behind). This loop is separated from the anterior loop by the meeting in the middle line of the third outer and the fourth inner reentrant angle; features characteristic of the European members of the subgenus *Pitymys*.—Fig. 29. *Mimomys pliocænicus*, young, right side, posterior portion broken off; Norwich Crag, Thorpe (Norw. Castle Mus. No. 971: Fitch Collection). The antero-external reentrant angle not yet reduced to an enamel islet. Cement-spaces beginning to be closed below.—Fig. 30. *Mimomys pliocænicus*, young, right side (Norwich Mus. No. 2708: from Gurney Collection). "Upper Fresh-water Bed, Ostend." Cement-spaces closed below; no roots developed. Enamel islet not yet formed.

form from the Norwich Crag and East Runton (text-fig. 13, no. 7), which has characters of its own; (3) Mr. Newton's name *intermedius* is restricted to the form or forms met with at West Runton (text-figs. 13, no. 1; 14, nos. 11-13; 15, nos. 21, 22, 25, 26) and a few from East Runton (text-fig. 15, no. 24). I am, however, quite convinced that at least double this number of species ought to be recognized, and am only prevented from doing so at present because I do not wish to found species on isolated teeth.

The larger Crag species is mainly characterized by the presence of the enamel islet, except in quite old specimens; by the earlier development of fangs; by the presence of an enamel islet in the last upper molar also; and by the presence of three roots in the two anterior upper molars, whereas in *M. intermedius* these same teeth have only two roots.

The four anterior lower molars of *M. intermedius*, in which the islet occurs, are all very little worn, although full-grown. It is therefore probable that the enamel islet will be found to be a constant feature in the young teeth of *M. intermedius*, but more ephemeral than in *M. pliocaenicus*. I propose to form a distinct genus, *Mimomys*, for all these Voles with rooted molars, which are clearly different from *Evotomys*, *Phenacomys*, and *Dolomys*. *M. newtoni* may prove, hereafter, to form a distinct genus.

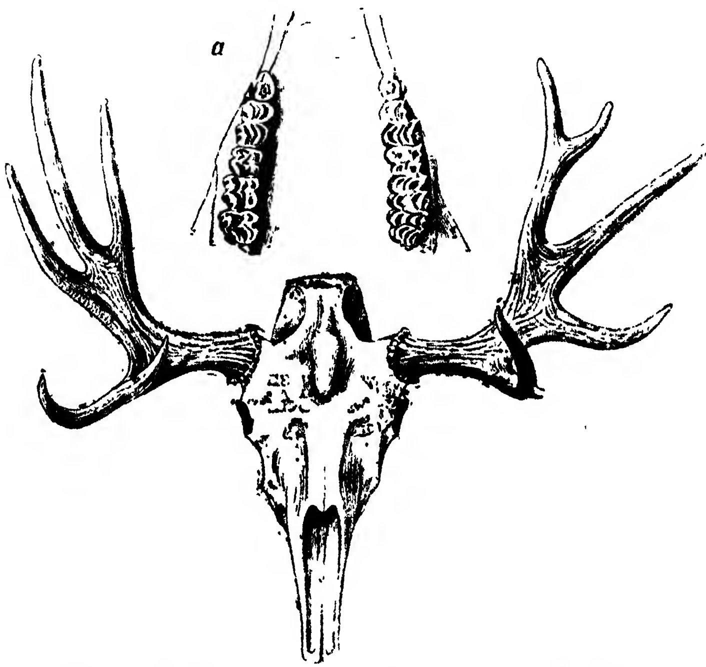
In the Savin Collection there are, besides those already referred to, about 17 fragmentary jaws and a small number of isolated teeth of *Microtus*, provided with rootless teeth throughout life; with one exception, a single anterior lower molar tooth from East Runton, they all came from the West Runton Upper Freshwater Beds. There are at least four different forms; several of them show in the conformation of their lower anterior molar some resemblance to such living forms as *M. arvalis* (text-fig. 15, no. 27), *M. nivalis* (text-fig. 15, no. 19), and *M. gregalis* (text-fig. 15, no. 18). On closer inspection I find, however, that, with the single exception of one isolated tooth, I can refer none of these remains to any recent nor to any hitherto known fossil species. The majority of the rami, ten in number, have nothing to do with the subgenus *Microtus*, but show in their anterior lower molar a feature (text-fig. 15, no. 28) which is characteristic of the European and some of the American members of *Pitymys*, and is found almost identical in the North-American *Pedomys*.

Mr. Lydekker exhibited the skull and antlers (text-fig. 16, p. 108) of an adult male Elk from Siberia, together with the antlers of a second example, lent by Mr. Rowland Ward.

The skull indicated an animal of at least 6 or 7 years old, the cranial sutures being for the most part obliterated, while the cheek-teeth were about half-worn. It was that of a somewhat older animal than the one to which an American skeleton mounted in the British Museum belonged. In the latter the palmation of the

antlers was well developed; but in both the pairs of antlers exhibited there was practically no palmation. These antlers were in fact very like those of young Scandinavian Elk, only with the palmation still less. They showed three tines on each side on the upper or hinder half of the main bifurcation, and either one or two tines on the lower or front branch. Mr. Lydekker had been informed that other Elk-antlers from Siberia were of a similar type.

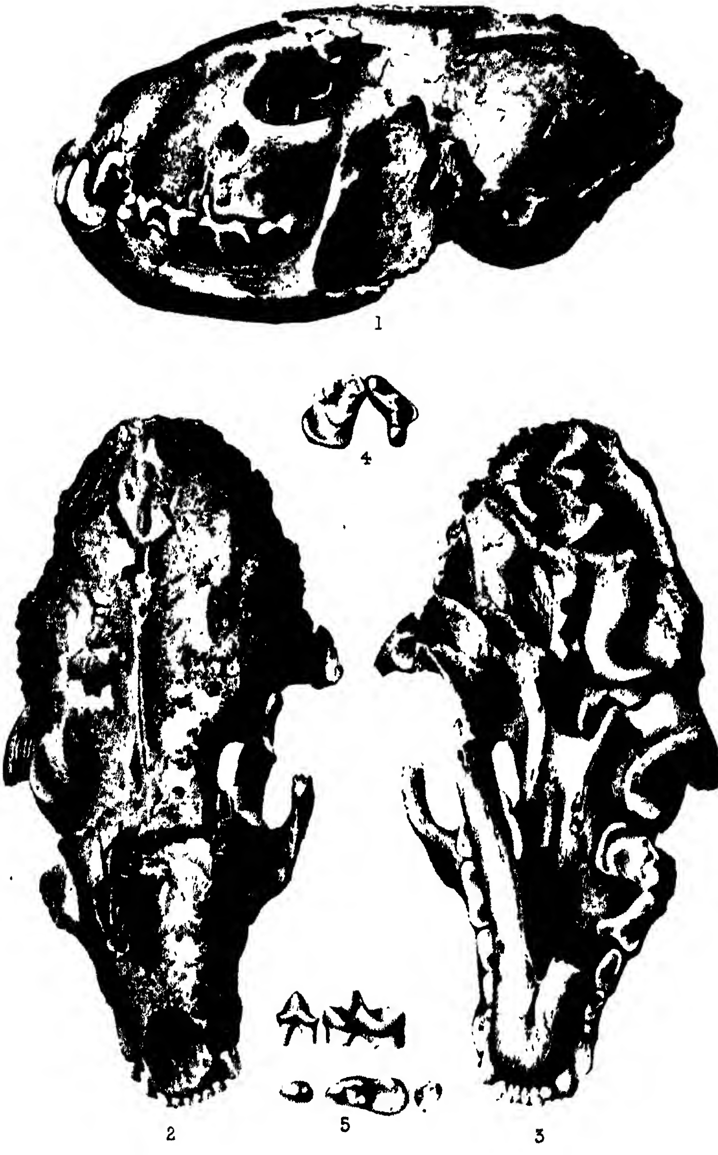
Text-fig. 16.



Skull and antlers, with the upper cheek-dentition (*a*), of Siberian Elk. From the type specimen in the Museum at Tring Park.

That the specimens exhibited were not the result of senile decadence was quite evident, not only from the symmetrical form of the antlers themselves, but likewise from the state of wear of the cheek-teeth (text-fig. 16, *a*) of the skull.

The similarity of the two pairs of antlers, together with the information as to this type being characteristic of all Elk-antlers from the same country, induced Mr. Lydekker to regard the Elk of Siberia as a distinct form. Whether it should be considered a species or a variety was a somewhat difficult question; but since the antlers exhibited involved a modification in the definition of the genus, it seemed advisable to allow specific rank in this case.



H Grönvold, del.

Photogravure by Bale & Danielsson L.td

SKULL OF MUSTELA PALÆATTICA.

Although in a recently published work Mr. Lydekker had suggested the possibility of the Siberian Elk proving distinct, so far as he was aware it had not yet received a name. An Elk with antlers not unlike those of the specimens exhibited had been described in 1847 by Rouillier, in Fischer de Waldheim's 'Jubilæum,' under the name of *Alces resupinatus*, based on a skull from a Pleistocene deposit in Russia. There did not appear, however, to be any characters by which that specimen could be distinguished from young skulls of the Scandinavian Elk.

Under these circumstances Mr. Lydekker proposed to name the Siberian Elk *Alces bedfordiæ*, in honour of the wife of the President of the Society. This species would be distinguished from both the Scandinavian and American races of *Alces machlis* by its non-palmated antlers, which carried only four or five tines on each side. The complete specimen exhibited would form the type.

The occurrence in Siberia of an Elk with antlers of the simple type of those exhibited was a fact of considerable interest, since that country was probably the centre whence both the European and American races of the true Elk were evolved.

[P.S.—Since this exhibition took place Mr. Lydekker had seen five other pairs of Elk-antlers from Siberia, all of the same form. Three of these specimens, together with the two exhibited, had been acquired by Mr. Walter Rothschild.

The following papers were read :—

1. On *Mustela palæattica* from the Upper Miocene of Pikermi and Samos. By C. I. Forsyth Major.

[Received December 17, 1901.]

(Plate VII.[1])

The type of Weithofer's *Mustela palæattica*[2], from Pikermi, is in the Vienna Museum. It is represented by a badly crushed skull (of which, however, the teeth, minus the incisors, are very well preserved), by the two almost intact mandibular rami, and by part of the skeleton. The whole was kept together and preserved from total destruction by being lodged between the rami of a *Hipparion* mandible.

The characteristic features of this species are furnished by the conformation of the upper and the talon of the anterior lower molar. Whilst the posterior upper premolar (*p.* 1) bears the characteristic features of *Mustela*, in its elongate outlines and the

[1] For explanation of the Plate, see p. 114.

[2] A. Weithofer, "Beiträge zur Kenntniss der Fauna von Pikermi bei Athen." [Beitr. Pal. Oesterreich-Ungarns, vi. pp. 226–231, pl. x. figs. 1–11 (1888).]

anteriorly situated small inner cusp, separated by a constriction from the blade, the molar approaches somewhat *Meles* by being more extended antero-posteriorly than in the recent species of *Mustela* proper, and by the presence of a third cusp to the inner side of the postero-external tubercle. Likewise, the lower *m.* 1 has its talon more complicated than in *Mustela.*

In the same year as Weithofer's publication I identified with his species an incomplete skull (the facial part missing)[1] which I had discovered in the contemporaneous deposits of Samos, in the locality Andrianò near the village Mitylini.

Schlosser[2] discusses Weithofer's type under the heading "*Meles? (Mustela) palæattica*," and unites with it an isolated upper molar, also from Pikermi, which he had formerly been disposed to regard as "*Martes pentelici* Gaudry," and which therefore bears this name in the explanation of his plate viii. (fig. 16). Two years later[3] Weithofer's type was registered by Schlosser as *Meles palæatticus.*

Von Zittel in his turn proposes for it the new generic name *Promeles*, and places it with the *Melinæ*[4]; whereas Winge refers *Promeles* to the *Mustelinæ*, and places it side by side with "*Martes*"[5].

In the Geological Museum of Turin I came upon the skull of a small Carnivore from Pikermi, which had been received many years before. It was kindly intrusted to me by Professors Parona and Sacco, and proved, when cleaned, to belong to the same species as the one described by Weithofer. Being so much more complete than my specimen from Samos, I have preferred to describe and figure the Turin specimen rather than the latter.

The skull is somewhat laterally compressed and otherwise distorted. Both zygomata are incomplete, the left one less than the right. The principal lesion is in the lateral region of the right side, the posterior part of the frontal and the parietal being lost. The mandible was in its natural position, and so firmly adhering to the skull, that to detach it as a whole would have been impossible without endangering the teeth. I determined therefore to sacrifice part of the right mandibular ramus—which was already damaged—rather than spoil the teeth, and succeeded in developing satisfactorily the *m.* 1, *p.* 1, and *p.* 2 of the right upper, and the *m.* 2, *m.* 1, and *p.* 1 of the right lower jaw.

Weithofer assigns to his specimen the size of *Mustela martes*, only slightly more robust; the teeth as figured show no signs of wear. The Turin specimen shows the teeth moderately worn, and, as will appear from the measurements, it was slightly larger than

[1] C. Rendus, 31 Dec. 1888, p. 1179. It is no. 272 of Mr. W. Barbey's collection at Valleyres (Switzerland). See Forsyth Major, 'Le Gisement ossifère de Mitylini et Catalogue d'Ossements fossiles recueillis à Mitylini, Ile de Samos,' p. 27, no. 272 (1894).

[2] Pal. Oesterr.-Ung. viii. p. 352 (1888).

[3] *Id. op. cit.* viii. p. 469 (1890).

[4] Handbuch der Palaeont. iv. p. 690 (1890).

[5] E Museo Lundi, (2) iv. pp. 66, 69 (1895).

the former. On comparing Weithofer's figure 1 (pl. x.) with my figures (Pl. VII.), the difference in size would appear still greater; but I find that the size of his figure does not in every respect correspond with the measurements given in the text, whereas, on the other hand, the statement on p. 228, that the upper series of cheek-teeth have together a length of 34 millim., is obviously a misprint: presumably we have to read 24 millim.

	Turin. mm.	Vienna. mm.
Greatest length of upper molar (*m.* 1) ...	7·5	6·5
,, breadth ,, ,, ...	10·5	10·0
,, length of upper carnassial (*p.* 1)	9·2	9·0
,, breadth of *p.* 1 underneath principal cusp[1]	4·0	3·7
Length of upper *p.* 2	6·0	6·0[2]
,, ,, *p.* 3	4·3	4·0[3]
,, ,, *p.* 4	2·5	

Length of the cheek-teeth series in the Turin specimen, from posterior border of third cusp of *m.* 1 to anterior margin of *p.* 3, 25·5 millim.

	Turin. mm.	Vienna. mm.
Length of mandibular ramus (from anterior basis of canine to condyloid process)	57·0	56·5
Height of coronoid process	29·0	29·0
From lower margin of foramen magnum to anterior basis of incisors	ca. 79·0	
From hinder margin of teeth-series to posterior palatal emargination	10·0	
Length of lower *m.* 2		
,, ,, *m.* 1	12·4	11·8
,, ,, *p.* 1	6·5	6·3
,, ,, *p.* 2	5·0	4·8
,, ,, *p.* 3	4·5	4·3
,, ,, canines at basis	5·7	

The six upper *incisors* are in place in the Turin specimen (Pl. VII. fig. 3); the anterior portion of the mandible remaining attached to the skull, only their anterior side is visible. They correspond perfectly with the incisors of *Mustela*, without any trace of the tricuspid condition of the blades exhibited by the upper incisors of *Meles*, *Mydaus*, *Helictis*, *Mephitis*, and *Conepatus*.

The upper *canines* are both broken, only the stumps remaining. Weithofer describes the upper canines of the Vienna specimen as being "etwas hakig nach rückwärts gebogen." In the *Melinæ* the upper canines are more in the shape of a dagger, the backward-

[1] The tooth of the Turin specimen being worn, the measurement of height is omitted.

[2] Weithofer terms this tooth *p.* 1. [3] Weithofer, sub *p.* 2.

curvature of the Musteline canines being absent or scarcely appreciable.

The anterior *premolar* (*p.* 4), absent in the Vienna skull, is present on both sides in the Turin specimen. I have nothing to add to Weithofer's description of the two following premolars (*p.* 2 and *p.* 3).

The perfectly Musteline character of the *upper carnassial* (*p.* 1) has already been mentioned. The only difference, already pointed out by the Austrian palæontologist, from recent species of *Mustela* is in the outer contour, which is almost convex in the fossil, slightly concave in recent species. The inner cusp is less constricted than in *M. martes*, *M. zibellina*, and *M. pennanti*, but resembles in this respect the *M. foina.*

Of the *upper molar* (*m.* 1) Weithofer says that it is different from that of all the other Mustelidæ, and he describes it minutely as follows[1]:—"Er ist bedeutend stärker entwickelt, mehr complicirt in der Richtung gegen den Dachs hin, ist überhaupt nur ein verkürzter Dachszahn mit allen den Elementen, die diesen charakterisiren. Die beiden äusseren Tuberkel des Marderzahnes sind viel stärker, stehen in ihrer Entwicklung in der Mitte zwischen Marder und Dachs und überdies ist bereits auch der dritte äussere Tuberkel des Dachszahnes vorhanden. Von diesem zieht sich eine höckerige, in zahlreiche kleine Tuberkel aufgelöste Wulst gegen innen, und, an der Innenseite das Zahnes, gegen vorne, welche in dieser Weise ebenfalls nur beim Dachs auftritt, noch nicht aber beim Marder. Zum Unterschiede von ersterem theilt sie sich jedoch in ihrem Verlaufe an der Innenseite rückwärts in zwei Aeste, welche beide die erwähnte grobe Körnelung besitzen. Der beim Dachs in der Mitte dieses Zahnes auftretende, von der Vorderecke ausgehende Kamm, der sich meist in drei Höcker auflöst und dessen Aequivalent beim Marder nur ein einfacher kleiner Tuberkel ist, ist hier auch als ziemlich langer, bogenförmig gekrümmter Kamm ausgebildet. Die Gesammtform des Zahnes ist eine mehr parallelopipedische, wenigstens ist die Vorder- und Hinterkante vollständig gleichlaufend, welche beim Marderzahn nach aussen stark convergiren. Es ergibt sich daraus eine besondere Ausdehnung des Aussenrandes, während ber Innenrand nur wenig grösser ist als beim Marder."

On comparing this minute description and the figure of the tooth (pl. x. fig. 1) with the specimen at my disposal (Pl. VII. figs. 3 & 4), we have to bear in mind that the teeth of the Vienna specimen are scarcely touched by wear, and that the granulations of the talon, of which there are only traces remaining in the worn tooth of the Turin specimen, are quite as conspicuous in unworn molars of recent *Mustelas* as they are in the Vienna tooth. The general form of the molar is dumbbell-shaped in *M. martes*, *M. zibellina*, *M. pennanti*, and *M. foina*. In Weithofer's specimen the outer and inner margins run perfectly parallel

[1] *Op. cit.* p. 228.

to each other, but in the Turin specimen there is a slight emargination on the posterior margin, internally from the third cusp; and the same may be seen in a fine skull of *M. palæattica* from Pikermi, which forms part of Dr. A. Smith Woodward's recent successful excavations at Pikermi. In the Valleyres, Turin, and London specimens the interior margin of the tooth is slightly more elongate than the exterior, so that the anterior and the posterior margins converge slightly towards the outer sides. Conversely, in the Indian Martens (the *M. flavigula* group) "this molar differs in form from that in *M. foina* and *M. martes* by having the inner lobe no broader from back to front than the outer."[1]

On the whole the fossil tooth differs from the molars of the *martes*-group by slight characters only. Now, the only reason for collocating the fossil within the *Melinæ* has been the shape of this upper *m.* 1, with which of course goes hand in hand that of the talon of the lower *m.* 1. It is, however, to be considered that a tooth situated at the posterior end of the series is always liable to vary more or less, and within the *Melinæ* in particular this tooth is by no means characteristic for the group. In *Helictis* it is quite narrow, the inner part not broader than the outer and the anterior and posterior margin almost parallel. In *Meles* the outer margin is much shorter than the inner, so that in this respect *Meles* agrees more with *Mustela martes* and allied species. In *Mephitis* and allies there is no trace of a third cusp, which, on the other hand, is present, although feebly developed, in the unworn molars of some species of *Mustela* (e. g., *M. pennanti*, *M. zibellina*), as also in unworn specimens of the South-African *Mellivora* (*M. ratel*), as well as in the *Vison*.

Far more characteristic is the upper carnassial (Pl. VII. figs. 3 & 4). In the *Mustelinæ* and in "*Promeles*" it shows the elongate form and the small anterior talon-cusp. The region of the cheek is more sharply separated than in recent *Mustela* from the nasal region by a blunt arcuate ridge, and in relation with this the depression in front of the orbits and above the infraorbital foramen is deeper.

The anterior and posterior roots of the zygoma rise almost vertically, so that the zygoma is shown to have a highly arcuate form, just as in *Mustela*.

The palate is more prolonged behind the molar series than in the recent species.

The under contour of the mandible is slightly more arcuate in the fossil than in *M. zibellina* and *M. martes*, and even more than in *Mustela foina* as described.

In all the *Melinæ* the carnassial is short and often provided with two or three talon-cusps. When there is only one (*Mephitis*), this is placed opposite the middle of the blade, and on either side connected by a cingulum with the antero- and the postero-

[1] W. T. Blanford, 'The Fauna of British India'—Mammalia, p. 159 (1888).

external margin of the blade, so that a valley is formed between the inner and the outer part of the tooth.

By the conformation of its upper carnassial, therefore, the fossil is excluded from the *Melinæ*—the upper and the lower one making only a slight approach towards the form they have in some members of this subfamily; whilst the characters of the skull and of the skeleton, so far as known, bring it likewise in closer connection with the *Mustelinæ* and with *Mustela* in particular. To emphasize this, it seems preferable to leave it in the latter genus, viz., to revive the name by which it was originally described—*Mustela palæattica* Weith.

EXPLANATION OF PLATE VII.

Skull of *Mustela palæattica* Weith., from Pikermi; Geological Museum, Turin.

All figures of the natural size.

Fig. 1. Side view. Fig. 2. Upper view. Fig. 3. Lower view. Fig. 4. Posterior upper premolar and molars, right side. Fig. 5. Lower true molars and posterior premolar, right side.

2. On Two new Genera of Rodents from the Highlands of Bolivia. By Oldfield Thomas, F.R.S.

[Received January 28, 1902.]

(Plates VIII. & IX.[1])

Mr. Perry O. Simons, the collector who has been doing such admirable work in the Andean chain, and to whose efforts we owe the discovery of a very large number of the mammals of that interesting region, has now sent home a collection from the high grounds of South-western Bolivia, from the Departments of Oruro, Potosi, and Sucre. Among these, besides some new species of known genera, described elsewhere, there are examples of two rodents so distinct as to demand generic separation, and I have therefore thought them worthy of being brought before the Society for description and illustration.

Neoctodon, gen. nov. (*Octodontidæ*.)

Tail comparatively bushy. Palms and soles granulated, the pads imperceptible.

Palatal foramina longer than in *Octodon*, the actual openings, instead of only the outer fossa, penetrating into the maxillæ.

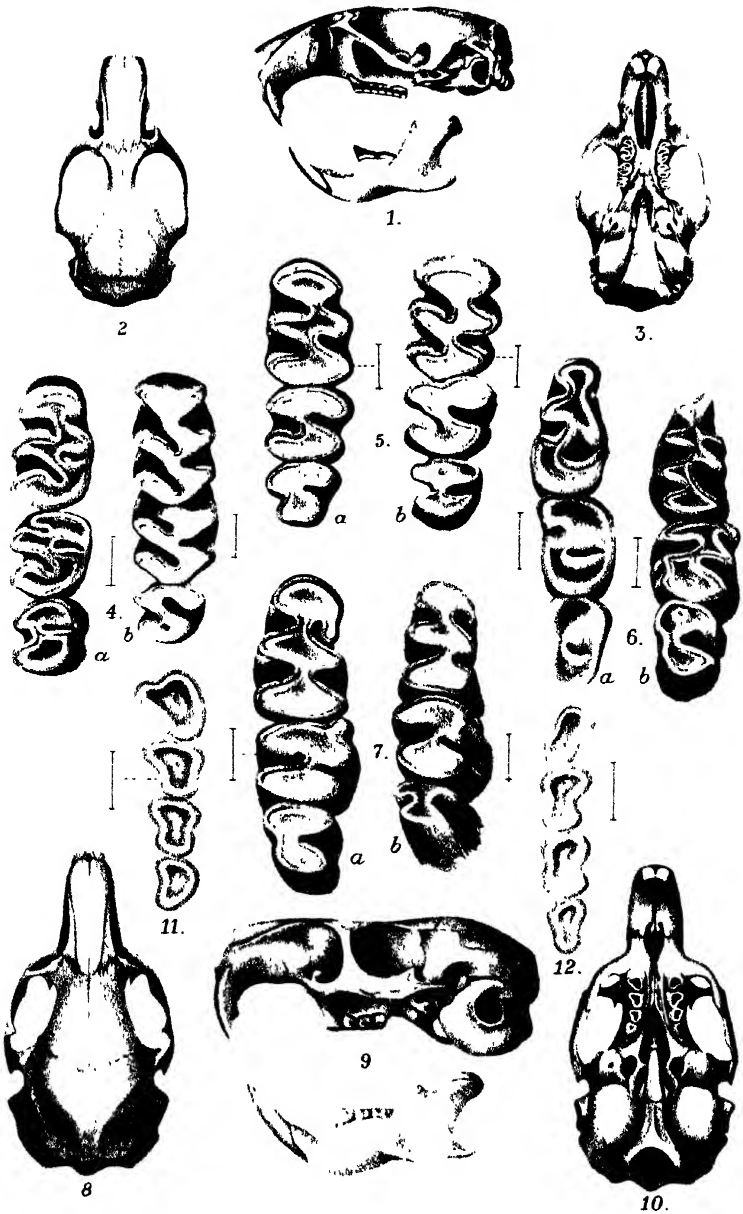
Incisors smooth, comparatively thick antero-posteriorly, their depth rather more than $1\frac{1}{2}$ their breadth, as compared with about $1\frac{1}{8}$ in *Octodon*.

Molars rootless, simpler than in *Octodon*, with a slight concavity on their outer side and none on the inner, there being no trace

[1] For explanation of the Plates, see p. 117.

J. Smit del. et lith. Mintern Bros imp.

NEOTODON SIMONSI



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1, 2, 3, 4A & 6A ANDINOMYS EDAX ADULT. 4B & 6B YOUNG OF Dᵀ
5A & 7A CHINCHILLULA SAHAMÆ, ADULT. 5B & 7B YOUNG OF Dᵀ
8 – 12, NEOCTODON SIMONSI; ADULT

of the deep internal enamel infolding found in that genus. The premolar rounded, triangular in section. Lower teeth oval in section, a slight median constriction on each side of m_1 and m_2.

This genus is, no doubt, closely allied to *Octodon*, of which it is a highland representative.

Neoctodon simonsi, sp. n. (Plates VIII. & IX. figs. 8–12.)

General appearance very much as in the North-American *Neotoma cinerea*, strikingly different, by paler colour, whiter belly, and longer, more bushy tail, from either of the species of *Octodon*. Fur soft and fine, hairs of back about 22 mm. in length.

General colour above pale drab-grey, grizzled with black. Sides clearer drab. Under surface snowy white, well defined laterally, where it extends rather high up; the bases of the hairs slaty except on the chin. Front of upper lip hairy, not grooved. Face coloured like the back, paler on the sides of the muzzle and cheeks; no definite markings round eyes. A few longer vibrissæ placed just above eye, and a more prominent tuft of them between eye and ear. Ears large, shaped about as in *Octodon*, finely covered with short greyish hairs; a distinct tuft of white hairs at their anterior bases. Outer sides of arms and legs like back, inner sides like belly; upper surface of hands and feet pure white, the hairs stiff and elongated terminally, so as to surpass the claws; palms and soles entirely naked, strongly granulated, with projecting cushions, on which the pads are so small as to be scarcely perceptible among the granulations; under the heel the surface is comparatively smooth; pollex with a broad flat nail; hallux short, with a claw, its tip falling some way short of the base of the second digit; fifth toe, without claw, reaching to the end of the basal phalanx of the fourth. Scrotum naked. Penis with a bone, which is flattened, tapering, though not to a point, about 15 mm. in length. Tail nearly as long as the head and body, thick, cylindrical, well clothed throughout with hairs, which increase in length to the end, where they may be fully an inch long. In colour the tail is brownish black above and at the end, white proximally on the sides and below; the hairs of the pencil-end are usually pale brown or even sandy brown, but this appears to be an effect of bleaching, more or less dependent on the season, as is the case in the British Squirrel.

Skull and teeth as shown in the figures.

Dimensions of the type, measured by Mr. Simons in the flesh:—

Head and body 184 mm.; tail 152; hind foot, s. u. 36, c. u. 38; ear 32.

Skull—greatest length 46, basilar length 38, greatest breadth 24; nasals $17 \times 5{\cdot}8$; interorbital breadth 10; length of frontal suture 13·5; breadth of brain-case 18·5; palate length 17·2; diastema 12; palatal foramina $4{\cdot}8 \times 2{\cdot}4$; length of upper tooth-series (crowns) 8·3; length of bulla 13; breadth of basi-occipital on suture 2·6.

Hab. Mountainous region south and south-east of the Titicaca-Poopo basin. Potosi, 4400 metres (type); Oruro, 3700 m.; Livichuco, 4500 m.; Challapata, 3800 m.

Type. Adult female. B. M. No. 2.2.2.2. Original number 1620. Collected October 1st, 1901, by Mr. P. O. Simons. 15 specimens examined.

Native names "Chockchuri" and "Achaco." "Found among rocks and cactus, in caves and old Indian tombs; nocturnal" (*Simons*).

I have had great pleasure in connecting with this very beautiful animal the name of Mr. Simons, in recognition of the remarkable collecting work he has done in the Andean chain during the last three years. His collections already number over 1600 mammals, more than 3000 birds, many hundreds of reptiles and amphibians, and large numbers of insects and other invertebrates.

ANDINOMYS, gen. nov. (*Cricetinæ*.)

Form murine. Thumb with a broad nail. Tail well-haired, but not pencilled.

Skull rat-like. Muzzle long, broad, and heavy. Interorbital region narrow, parallel-sided, without ridges. Palatal foramina large, with very sharply defined edges. Bullæ small.

Incisors heavy, smooth anteriorly. Molars very large, highly hypsodont, as in *Chinchillula*, but their pattern more as in *Phyllotis*, though with almost a microtine appearance in youth, when they are much more complicated than would be at all easily perceived from their structure in adult life (see figures).

This genus, like *Chinchillula*[1], is a highly hypsodont and heavily toothed relative of *Phyllotis*, itself more hypsodont than the brachyodont *Eligmodontia*. But in *Chinchillula* the teeth are remarkably simple, practically alike in youth and age, with opposite and connected enamel-spaces, as shown in the figures (Plate IX. figs. 5, 7). In *Andinomys*, on the other hand, the spaces are more or less alternated, the pattern, especially of m_1, becomes less complicated with age owing to the wearing-out of accessory columns, and the spaces are or gradually become isolated from each other; the lateral angles are much more acute in youth, becoming comparatively blunt in old age.

ANDINOMYS EDAX, sp. n. (Plate IX. figs. 1–4, 6.)

General appearance of a large *Phyllotis* or soft-haired *Oryzomys*. Fur long, fine and soft, but not woolly; hairs of back about 19–20 mm. in length. General colour above dull buffy or fulvous buffy, lined with black; sides clearer, sandy buffy; under surface not sharply defined, buffy white, the hairs slaty basally. Head like body; no orbital markings. Ears fairly large, closely haired, brown

[1] *Chinchillula* was originally founded (Ann. Mag. N. H. (7) i. p. 280, 1898) on a single immature skin, but the British Museum now possesses a series of adult examples collected by Mr. Simons at Caylloma, Peru.

outside and in, their edges whitish. Upper surface of hands and feet well-haired, the hair of the ends of the digits surpassing the claws, silvery white; fifth hind toe, without claw, reaching to the middle of the second phalanx of the fourth; palms and soles naked, the pads large, rounded and prominent.

Skull with large nasals, very broad anteriorly. Interorbital region narrow, parallel-sided, concave in the middle line, the concavity bordered by low rounded and inconspicuous ridges, which do not overhang the orbit or run back on to the parietals. Interparietal large and broad. Anterior plate of zygoma-root concave anteriorly, with an overhanging point above. Palatal foramina very long and open, broadest mesially, running to a sharp point behind, where they reach to the level of the first lamina of m^1, their edges very sharp and clearly defined. Posterior nares level with the back of m^3, comparatively broad. Bullæ small.

Dimensions of the type, measured in the flesh by Mr. Simons:—

Head and body 160 mm.; tail 145; hind foot, s. u. 29, c. u. 30; ear 25.

Skull—greatest length 37; basilar length 31; nasals 15·2 × 6·1; interorbital breadth (on the convex surface low down) 4, between the rudimentary ridges 2·1; breadth of brain-case 14; interparietal 4·3 × 10; zygoma-root 3; palate length 18; diastema 10·1; palatal foramina 9·6 × 3·2; length of upper molar series 7; combined breadth of upper incisors 3.

Hab. El Cabrado, between Potosi and Sucre, Bolivia. Altitude 3700 metres.

Type. Old female. B. M. No. 2.2.2.15. Original number 1568. Collected September 20th, 1901, by P. O. Simons. Two specimens.

A young specimen, apparently of the same species, had been previously obtained by Mr. Simons at La Paz, altitude 4000 m.

Mr. Simons says of this animal: "Caught in thicket of oak-like bushes; nocturnal."

Owing to its extreme general resemblance to *Phyllotis*, the young specimen from La Paz had been supposed to be an example of that genus with a wrongly numbered skull, but the later examples prove that Mr. Simons was in this instance, as usual, entirely correct in his labelling.

EXPLANATION OF THE PLATES.

Plate VIII.

Neoctodon simonsi, p. 115.

Plate IX.

Figs. 1, 2, 3. *Andinomys edax* (p. 116), skull.
Fig. 4. *Andinomys edax*, right upper tooth-row: *a*, adult; *b*, young.
5. *Chinchillula sahamæ* (p. 116), right upper tooth-row: *a* & *b* as before.
6. *Andinomys*, right lower tooth-row: *a* & *b* as before.
7. *Chinchillula*, right lower tooth-row: *a* & *b* as before.
Figs. 8, 9, 10. *Neoctodon simonsi* (p. 115), skull.
Figs. 11, 12. *Neoctodon*, right upper and right lower tooth-rows.

3. On some new Mammals from Northern Nyasaland. By Oldfield Thomas, F.R.S.

[Received February 4, 1902.]

Since my last paper on the mammal-fauna of Nyasaland, a number of further specimens from that country have been contributed to the National Museum by Mr. Alfred Sharpe, C.B., Commissioner, and Col. Manning, Deputy Commissioner, collected by themselves, Mr. J. McClounie, Mr. J. B. Yule, Capt. Pearce, and others.

Without occupying space by recording the known species sent, the present paper, the seventh of the series, gives descriptions of the new species contained in the collection.

Opportunity has also offered for a re-examination of the Nyasan *Colobus*, and, as it proves to be new, it is now described.

Colobus sharpei, sp. n.

Coloration exactly as in *C. palliatus* Peters[1], to which this species has hitherto been referred. Pelage rather closer and longer, the hairs of the middle back 5-6 inches in length and those of the mantle 10-12.

Skull decidedly larger in every dimension than that of *C. palliatus*. Frontal region much more convex, and also as it were higher up the skull, so that the middle point between the ridges is in side view over m^2 or m^1, while in *C. palliatus* it is over m^1; the distance from the same spot to the tip of the nasals is nearly half as much again in the new form (23 mm. as against 16), and the nasals themselves are both longer, broader, and less acutely pointed behind. Zygomata stronger, the vertical height of the malar just in front of the squamosal suture 10 instead of about $5\frac{1}{2}$ or 6 mm. Zygomatic arches strongly divergent posteriorly, nearly parallel in *C. palliatus*. Front edge of coronoid process of lower jaw angularly convex forwards. The other cranial differences observable seem all to be dependent on the greater size of *C. sharpei*.

Dimensions (approximate) of a stuffed specimen, not the type:- Head and body 680 mm.; tail 760; hind foot 190.

Dimensions of the typical skull, that of an old female:—Greatest length in middle line 115 mm.; condylar length, from back of condyles to gnathion, 101; zygomatic breadth 85; nasal opening, height 21, breadth 10; nasals, length in middle line 16, breadth 10; least interorbital breadth 10; orbit, height 26, breadth 27; vertical height from palate to frontal behind supraorbital ridges 38·5; palate length from gnathion 49·5; combined length of upper premolars and molars 33·6, of upper molars 23, of lower premolars and molars 38, of lower molars 25.

Hab. Nyasa-Tanganyika Plateau. *Type* from Fort Hill.

[1] Figured, MB. Ak. Berl. 1879, p. 832, pl. iv A.

Type. Old female. B.M. No. 97.7.3.1. Collected by J. B. Yule, and presented by Alfred Sharpe, Esq., C.B.

It has always been a matter of surprise that the *Colobus* of the high Nyasa-Tanganyika plateau should be the same as that occurring in the hot lowlands opposite Zanzibar, but the markings are so nearly identical that no one has hitherto been able to separate the two forms. Now, however, that the British Museum has received from Mr. A. B. Percival three fine adult females of the true *C. palliatus* from Takaungu, British East Africa, with their skulls, I am able to show that the two are separable, the skull-differences being really considerable.

I have much pleasure in naming this fine species after my friend, Mr. Alfred Sharpe, C.B., Commissioner of British Central Africa, to whose interest and patriotism the National Collection of Nyasan Mammals is so largely indebted.

Colobus sharpei is the *C. angolensis* of Sclater (1892), and more recently the *C. palliatus* of Pousargues, Neumann, and myself.

HELOGALE VARIA, sp. n.

Size rather large. Fur close and fine. General colour above finely speckled yellowish or buffy grey, passing gradually below into deep buffy without speckling. Posterior back of all four specimens, in bleached pelage, dull yellowish or "clay-colour." Head conspicuously different to back, clear deep grey without yellowish suffusion; a small patch on each side of the muzzle running back to surround the eye brown or brownish rufous. Ears grey above, deep yellowish below. Upper surface of hands and feet dark yellowish clay-colour, scarcely grizzled at all. Tail coloured like back.

Skull with the nasals broad and parallel-sided for their anterior half, then abruptly narrowing to a point posteriorly.

Dimensions (approximate) of the type, measured in skin:—Head and body 270 mm.; tail 162; hind foot (wet) s. u. 46; ear (wet) 18.

Skull (of the type, nasal sutures still showing) greatest length in middle line 53; zygomatic breadth 28·5; nasals 9×5; interorbital breadth 9·1; breadth of brain-case above meatus 91·7; palate length from gnathion 24·5; greatest diameter of p^4 5·2.

Type. Sub-adult. B.M. No. 2.1.6.5. Four specimens examined.

This *Helogale*, of which four perfectly similar specimens are in the collection, differs from all others by the head being much darker-coloured than the back, these parts being quite concolor in the other forms. Whether the much greater yellowness of the rump will also prove a constant character I cannot say, as in all the skins the fur of this part is worn and faded

The recognizable forms of *Helogale* seem to be as follows:—

(1) HELOGALE ATKINSONI Thos.

Helogale atkinsoni Thos. Ann. Mag. N. H. (6) xx. p. 377 (1897).

Face, crown, and back uniformly grizzled grey. Under surface dull greyish brown, more fulvous on throat and inguinal region. Feet grizzled greyish proximally, fulvous on digits.

Hab. Abyssinia and Somali.

(2) HELOGALE UNDULATA Peters.

Herpestes undulatus Peters, Reise Mossamb. p. 114, pl. xxv. (1852).

Body grizzled greyish, more or less suffused with rufous. Face, especially muzzle, strongly rufous. Crown like back. Under surface dull greyish brown. Hands and feet deep rufous.

Hab. British East Africa, German East Africa, and Mozambique.

(3) H. VICTORINA, sp. n.

Body pale grizzled grey, suffused with ochraceous yellow. Muzzle fulvous. Crown like back. Under surface from chin to anus dull buffy yellow. Hands and feet also buffy yellow. Tail like body above, buffy below.

Head and body of type 243 mm.; tail 145; hind foot, s. u. 44. Skull—greatest length 52; zygomatic breadth 31; palate length 2·5; greatest diameter of p^4 5·5.

Type. Male. B.M. No. 93.5.1.2. Collected October 25, 1892. by the Rev. F. C. Smith. Presented by Canon Tristram. Three specimens examined.

Hab. Region of the Victoria Nyanza. *Type* from Nassa, on Speke Gulf, south end of the lake. Usambiro, Victoria Nyanza (*Emin Pasha*).

(4) H. VARIA Thos.

As above.

(5) H. PARVULA Sund.

Herpestes parvulus Sund. (Efv. K. Vet.-Ak. Förhandl. 1846, p. 121.

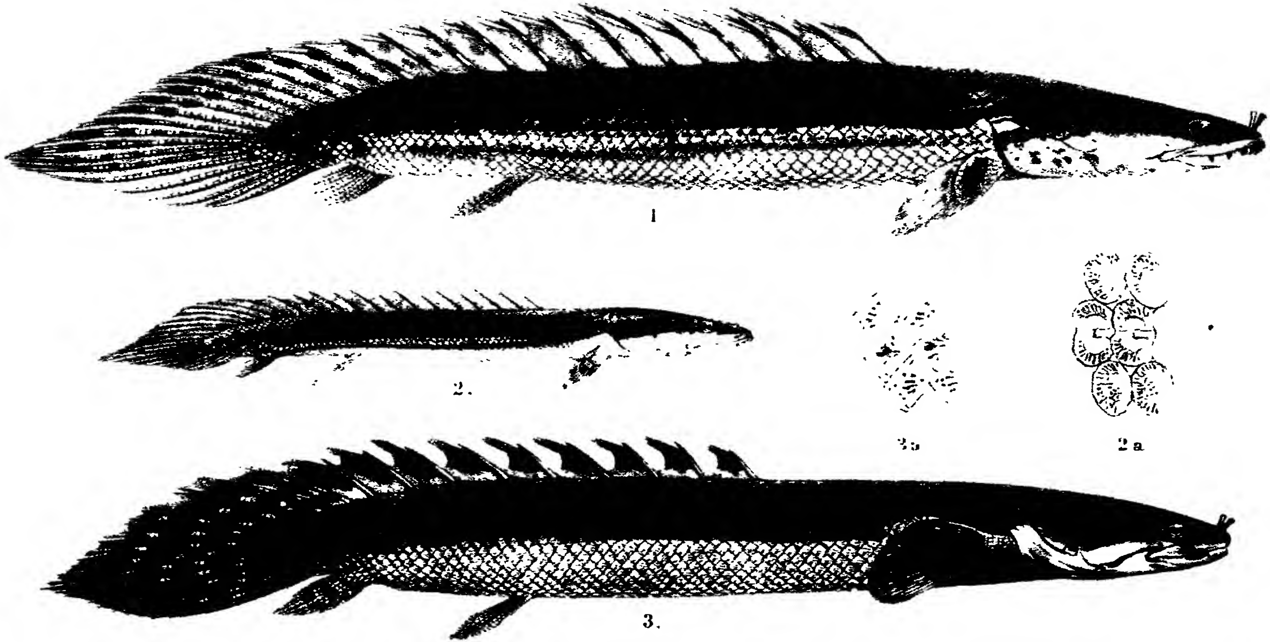
Size small. Colour uniformly dark, finely grizzled brown throughout, on head, body, belly, and limbs.

Hab. S.E. Africa: Natal, Zululand, &c.

FUNISCIURUS YULEI, sp. n.

No stripes. Premolars $\frac{2}{1}$.

Superficial appearance somewhat as in *F. cepapi*. Size rather larger than in that species. Fur of medium harshness; hairs of back about 10 mm. in length. General colour above pale coarsely grizzled tawny, greyer over the shoulders, though this may be due to old age. Sides greyish tawny, much lighter than the dorsal area, though the line of distinction is not sharply defined. Under surface ill-defined whitish, whiter on the chest and groins, mixed with greyish on the belly. Sides of muzzle and rings round eyes whitish. Crown grizzled tawny. Ears comparatively



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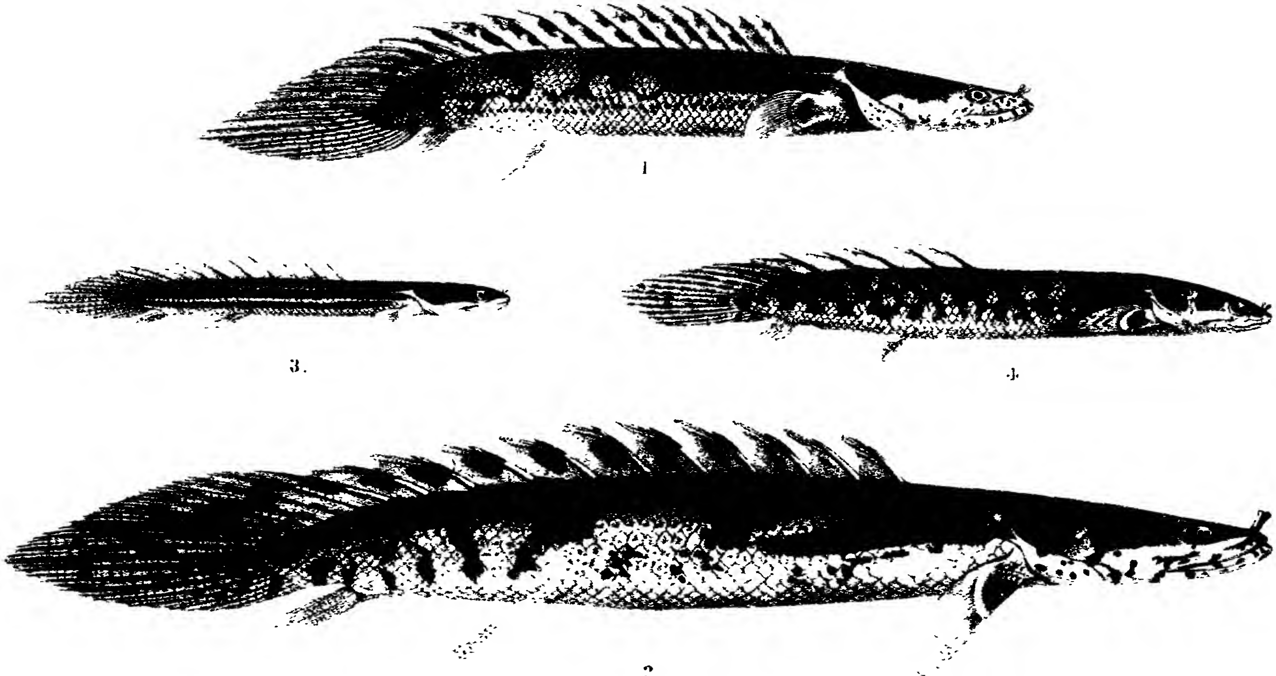
1, 3. POLYPTERUS LAPRADII. 2. P. WEEKSII.



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1. POLYPTERUS CONGICUS 2. P. ENDLICHERI 3. P. SENEGALUS 4. P. PALMAS

large, whitish, especially at their edges. Arms and legs like sides; hands and feet heavily built, their upper surfaces greyish white; soles naked except under the heels. Tail but little bushy, its hairs broadly ringed with black and pale yellowish, their tips whitish.

Skull rather heavier than that of *F. cepapi*. Nasals broad, expanded posteriorly. Interorbital region broad, flat or slightly concave: postorbital processes well developed, projecting directly outwards instead of backwards. Premolars $\frac{2}{1}$. Molars heavier than in *F. cepapi*.

Dimensions (approximate) of the type, measured in skin:—Head and body 205 mm.; tail 145; hind foot s. u. (wet) 41; ear (wet) 19.

Skull - henselion to basilar suture 28; nasals, length 12·5, least breadth 5, posterior breadth 6; interorbital breadth 12; tip to tip of postorbital processes 19; intertemporal breadth 13: palate length from henselion 18·5; diastema (to front of p^4) 10·6; length of tooth-row (omitting the small p^3) 8. Lower jaw, condyle to incisor-tip 27·7.

Hab. Muezo, near Lake Mweru.

Type. Old male. B.M. No. 2.1.6.8.

It is difficult to say to which species *F. yulei* is really most closely allied. Externally it has a certain resemblance to *F. annulatus*, but that animal has only one upper premolar and differs in many other details. From *F. cepapi*, found in the same region, it is distinguished by its larger ears, grey instead of fulvous limbs, whitish feet, larger molars, and other points both external and cranial.

I have connected with this distinct Squirrel the name of Mr. J. B. Yule, of the official staff of the Protectorate, by whom a large number of the North Nyasa specimens described now and in former papers have been collected.

4. On some Characters distinguishing the Young of various Species of *Polypterus*. By G. A. Boulenger, F.R.S.

(Received January 28, 1902.)

(Plates X. & XI.[1])

The increased interest which has lately been paid to the remarkable African Crossopterygian *Polypterus* has resulted in a better understanding of the characters by which the species can be distinguished[2], and the recent exploration of the Congo has added several forms, fully entitled to specific rank, which were undescribed[3].

[1] For explanation of the Plates, see p. 125.

[2] *Cf.* Boulenger, Ann. & Mag. N. H. (7) ii. 1898, p. 416.

[3] *Cf.* Boulenger, Poiss. du Bass. du Congo (1901), and Ann. Mus. Congo, Zool. ii. (1902).

We can now distinguish ten *Polypteri*:—

1. *P. bichir* Geoffr.—Nile.
2. *P. lapradii* Stdr.—Senegal, Gambia, Niger.
3. *P. congicus* Blgr.—Congo, L. Tanganyika.
4. *P. endlicheri* Heck.— Nile, Niger.
5. *P. delhezi* Blgr.—Congo.
6. *P. ornatipinnis* Blgr.—Congo.
7. *P. weeksii* Blgr.—Congo.
8. *P. senegalus* Cuv.—Nile, L. Rudolf, Senegal, Gambia, Niger.
9. *P. palmas* Ayres.—West Africa, from Liberia to the Congo.
10. *P. retropinnis* Vaill.—Congo.

Not before 1869 was anything known of the characters of the young. We owe the first observations on this subject to Steindachner[1], who, on his return from a collecting expedition to the Senegal, announced the startling discovery that both *P. lapradii* and *P. senegalus* are provided, for a certain period, with a large external opercular gill similar in structure to those possessed by Tailed Batrachians. In 1896[2], I noticed the presence of external gills in *P. palmas*, and successively in specimens of *P. congicus*, *lapradii*, and *weeksii*[3]. In his highly interesting memoir on the Breeding-habits of some West-African Fishes[4], Mr. Budgett has made us acquainted with the external appearance of a specimen, referred by him to *P. lapradii* (but which he informs me, after examination of the Nigeria specimens sent by Dr. Ansorge, should be referred to *P. senegalus*), smaller than any previously obtained and which may be regarded as truly larval. Having recently received, from various sources, a number of young specimens from the Nile, the Congo, and Nigeria, I am able to supplement our present knowledge on various points. The notes here offered deal with six species: *P. lapradii*, *P. congicus*, *P. endlicheri*, *P. weeksii*, *P. senegalus*, and *P. palmas* It will be observed that the young of *P. bichir*, the oldest known species, the only one to occur in the Lower Nile, is still undescribed.

Before proceeding to descriptive details, I wish to observe that the specimens with external gills at present known may be arranged in three divisions:—(1) Without scales, and with the dorsal fin spineless, not differentiated from the caudal; the only example known being the larval specimen of *P. senegalus*, brought home from the Gambia by Mr. Budgett and described and figured by him. (2) With scales of a cycloid type and with the dorsal fin as in the preceding. (3) With all the essential characters of the mature form. Although the scales may, in the very

[1] Sitzb. Akad. Wien, lix. i. 1869, p. 103.
[2] Ann. & Mag. N. H. (6) xvii. 1896, p. 310.
[3] Ann. & Mag. N. H. (7) ii. 1898, p. 419, and P. Z. S. 1898, p. 493, 1899, p. 554, 1900, p. 267.
[4] Trans. Zool. Soc. xvi. 1901, p. 115.

young, differ so greatly in shape, their numbers are the same as in the adult, and, though devoid of spines and in no way "pinnules," the rays of the dorsal fin are identical in number; only, as it is practically impossible to establish a limit between them and those of the caudal, it is preferable to count the rays right to the extremity of the vertebral column.

POLYPTERUS LAPRADII Stdr. (Plate X. figs. 1 & 2.)

This is one of the largest species, growing to a length of 740 millim. The largest specimen with fully developed opercular gills, obtained by the late P. Delhez at Kaëdi, Senegal, measures 300 millim., and is the largest *Polypterus* with external gills yet recorded; the specimens in which the external gills were discovered by Steindachner measured up to 230 millim. These gills are retained, as a rule, until the young is 240 to 260 millim. in length, but they vary in the degree of development irrespective of the size of the specimen, and sometimes also on the two sides.

Four young specimens, measuring 94, 98, 114, and 205 millim. respectively, were obtained at Assay and Abo, Southern Nigeria, in October last by Dr. W. J. Ansorge, to whom ichthyology is indebted for so many striking discoveries in that part of Africa.

In the smallest specimen the external gill measures 30 millim., the dorsal rays are all simple and spineless, 23 in number, and the scales are very thin, circular, juxtaposed, and only well developed about the lateral line and on the tail; the caudal fin is acutely pointed, the median rays being produced and as long as the head. A black band extends on each side from the end of the snout, through the eye, to the base of the external gill, which is likewise black, and along the body to the base of the caudal fin; this band, on the body, is about as broad as the eye; below it a narrower black band extends from the shoulder to the anal fin. In the two next specimens the external gills measure 33 and 50 millim. respectively. In the largest specimen, the right external gill measures 68 millim., the left 53; the scales are well developed, rhomboidal and imbricate, and the dorsal spines (14 in number, followed by 10 soft rays to the extremity of the vertebral column) are ossified and bicuspid, supporting three articulated rays to form the "pinnule." The dark bands are more indistinct and crossed by bars on the caudal region.

POLYPTERUS CONGICUS Blgr. (Plate XI. fig. 1.)

This species appears to be the largest of the genus, growing to one metre. I have already reported upon specimens up to 260 millim. provided with the external gill, and one of them has been figured in the 'Annales du Musée du Congo.' It appears that in this species, as in *P. lapradii*, the external gills are normally retained until comparatively late. A specimen recently received from Banzyville on the Ubangi, and belonging to the Congo Museum, is interesting as being the smallest yet obtained of that species.

It measures 118 millim., the external gill being 25 millim. long. In its development it is intermediate between the two stages noticed above in *P. lapradii*. The dorsal spines are not yet defined, the number of rays being 22 to the extremity of the vertebral column; the scales are imbricate, cycloid, with a tendency to the rhomboid shape, rugose, with a smooth central area corresponding to the part of the scale first to appear. Six blackish bars across the back, bifurcating on the sides; below these bars, two interrupted blackish lines run along each side.

POLYPTERUS ENDLICHERI Heck. (Plate XI. fig. 2.)

I have seen only one young specimen of this *Polypterus*, obtained at Abo, Nigeria, by Dr. Ansorge in October. It measures 180 millim., the external gill 30, and corresponds in its development with the largest specimen of *P. lapradii* obtained by Dr. Ansorge in the same locality. The spines number 11, and are followed by 8 soft rays. The coloration does not differ from that of the adult.

POLYPTERUS WEEKSI Blgr. (Plate X. fig. 3.)

The type on which this species was established in 1898 is a young specimen, 170 millim. long, with external gills measuring 15 millim., obtained at Monsembe, Upper Congo, by the Rev. J. H. Weeks, from whom the British Museum has since received a specimen 380 millim. long and without external gills, obtained at the same locality. The young specimen, which is here figured, is in what I have defined above as the third period. It is dark olive above, yellow beneath, the two colours sharply delimited on the side; six narrow black bars across the back, with some black spots between them, the last followed by irregular marblings; a large black spot on the membrane to each dorsal spine; soft fins with dark and light spots; pectoral with three blackish cross-bands. I have already observed that the asperities on the scales, which are so striking in the young, disappear in the adult.

POLYPTERUS SENEGALUS Cuv. (Plate XI. fig. 3.)

This species differs from all its congeners in being of a uniform greyish olive, without any markings, at least in specimens above 120 millim. total length; but the very young, with which we have only quite recently become acquainted, are striped, as described hereafter. The external gills appear to be lost very early; for they have not yet been found in any specimen above 90 millim., although a large number of young have been examined by Steindachner, Budgett, and myself.

Two small specimens, measuring 60 and 69 millim. respectively, were obtained by Mr. Loat in the White Nile, at the mouth of Lake No, in the beginning of February 1901. In both, the external gills are present and measure 5 millim. The smaller specimen has 8 spines and 8 soft rays to the dorsal, the larger

9 spines and 7 soft rays; in both the 5 anterior spines are not fully formed, not bicuspid, whilst the others have already assumed their definite shape; the caudal fin is long, with the median rays produced, a little longer than the head; the scales are imbricate and rhomboidal, striated, except on the central areola. A dark brown band on each side, from the end of the snout, through the eye and over the external gill, to the base of the caudal; another dark band, only a little narrower, below the first along the body, separated from it by a narrow yellowish streak. The very young of *P. senegalus* is therefore banded like that of *P. lapradii*, with this difference, that the lower band is broader in proportion to the upper.

Dr. Ansorge's Nigeria collection contains several young with external gills, obtained at Abo in October 1901; the length of these specimens varies between 39 and 105 millim. In the largest the external gill is present only on the left side and measures 9 millim.; the dorsal spines, 9 in number, are bicuspid, the scales are nearly smooth, and mere traces of the dark bands are visible: the other specimens agree entirely in their markings with those obtained by Mr. Loat in the White Nile, and show the complete passage from cycloidal to rhomboidal scales, and of simple dorsal rays to pinnules with spines, the posterior of the latter being developed first.

Polypterus palmas Ayres. (Plate XI. fig. 4.)

This species is closely allied to *P. senegalus*, and in it also the external gills do not persist long. I have only observed them in one specimen 95 millim. long, where they measure 8 or 9 millim.; in all other specimens examined, measuring 80 millim. and above, I have found them to be absent.

The body is brownish above, yellowish beneath; the upper parts are marked with darker cross-bars, close together, which branch off into marblings or a wide-meshed network on the sides, enclosing roundish yellowish spots; or the dark and light spots may be arranged in chess-board pattern on the sides; a blackish oval spot on the peduncle of the pectoral fin.

EXPLANATION OF THE PLATES.

Plate X.

Fig. 1. *Polypterus lapradii* Stdr., p. 123, young from Abo, S. Nigeria, slightly reduced.

2. Younger specimen of the same species, from Assay, S. Nigeria, nat. size, with (2 *a*) enlarged view of scales from the middle of the side.

3. *Polypterus weeksii* Blgr., p. 124, young from Monsembe, Congo, nat. size, with (3 *a*) enlarged view of scales from the middle of the side.

Plate XI.

Fig. 1. *Polypterus congicus* Blgr., p. 123, young, from Bangyville, Ubangi.

2. *Polypterus endlicheri* Heck., p. 124, young, from Abo, S. Nigeria.

3. *Polypterus senegalus* Cuv., p. 124, young, from Assay, S. Nigeria.

4. *Polypterus palmas* Ayres, p. 125, young, from Monsembe, Congo.

[All figures of the natural size.]

5. Description of a New Snake of the Genus *Psammophis*, from Cape Colony. By G. A. Boulenger, F.R.S.

[Received February 17, 1902.]

(Plate XII.)

Psammophis leightoni. (Plate XII.)

Snout once and two thirds as long as the eye, with a shallow concavity in front of the vertex. Rostral a little broader than deep, visible from above; nostril between three shields; internasals shorter than the præfrontals; frontal twice as long as broad, in the middle about two thirds the width of the supraocular, as long as its distance from the end of the snout, slightly shorter than the parietals; loreal twice as long as deep; a single præocular, forming an extensive suture with the frontal; two postoculars; temporals 2+2; eight upper labials, third deeper than second and fourth, fourth and fifth entering the eye; four lower labials in contact with the anterior chin-shields, which are shorter than the posterior. Scales in 17 rows. Ventrals 156; anal divided; subcaudals 84. Dark brown above; the middle row of scales black with yellow shafts forming an interrupted light vertebral line; a yellow lateral streak along the adjacent halves of the third and fourth rows of scales; the upper half of the fourth scale black; scales of outer row yellow in front and brown or black behind; sides of neck with dark ocelli edged with bright yellow; head dark brown above, with a yellow line along the middle of the snout and another on each side of the frontal shield; two pairs of yellow spots on the parietal shields; four yellow bars on each side of the head, the first on the præocular, the second on the postoculars, the third extending to the upper surface of the head and nearly meeting its fellow on the occiput; rostral and labials yellow, with black spots; lower parts yellowish white, with black dots and two bluish-grey longitudinal lines which widen forwards into two bands and unite on the throat.

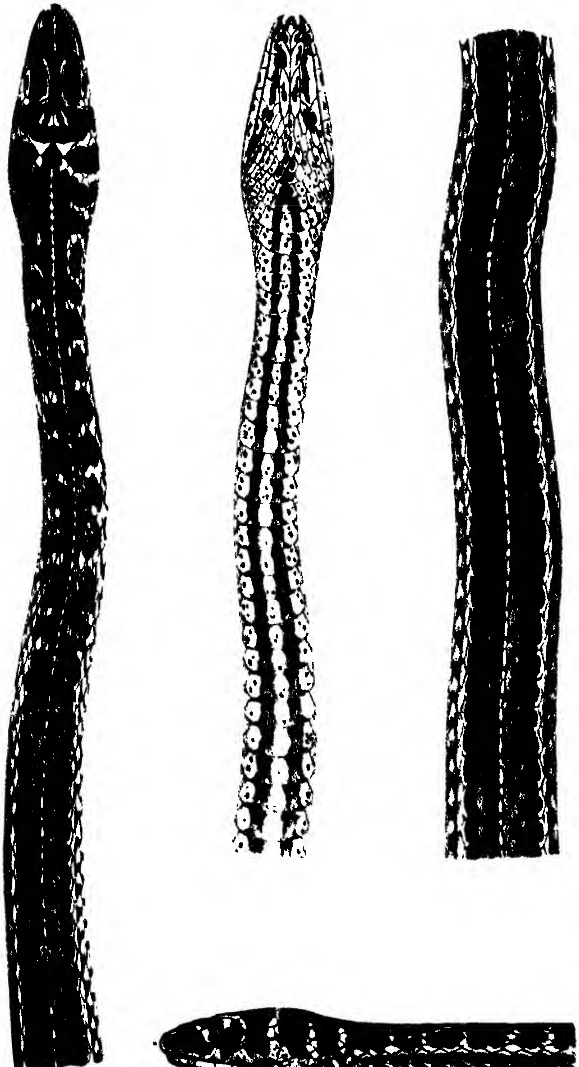
Total length 910 mm.; tail 270.

A single specimen, from Eerste River Station, 21 miles east of Cape Town, was received by Dr. G. Leighton, of Pontrilas, Hereford, and presented by him to the British Museum.

In its markings this Snake differs from all its congeners. It differs from *P. sibilans* in having the rostral shield broader than deep, as in *P. notostictus*, in which the præocular and the anal are divided.

EXPLANATION OF PLATE XII.

Psammophis leightoni. Upper, lower, and side views of head and anterior part of body and upper view of middle part of body. Natural size.



P. J. Smit. del. et lith.

Mintern Bros. imp.

PSAMMOPHIS LEIGHTONI

6. Observations upon the Carpal Vibrissæ in Mammals. By FRANK E. BEDDARD, M.A., F.R.S., Vice-Secretary and Prosector of the Society.

[Received December 24, 1901.]

(Text-figures 17–21.)

In a brief note in 'Nature'[1], and incidentally in a paper devoted to the anatomy of *Bassaricyon*[2], I directed the attention of zoologists to a tuft of long and strong hairs which exist in many mammals on the wrist close to the root of the thumb and generally on that (the radial) side of the forearm. These long hairs are quite similar in character to those which are found in various parts of the head and face of many mammals, such as, for example, the "whiskers" of the domestic cat. They are readily seen on account of their size; and, as a rule, they are also conspicuous by reason of the fact that they are frequently, though not always, of a different colour from the hairs of the surrounding pelage. But if they escape the eye, as is sometimes the case in the skins of spirit preserved specimens, they can be felt through the skin on account of the large hair-bulbs which receive the proximal ends of the hairs. That these structures must be of some use to their possessors seems to be obvious, and yet is not easy to prove. I have watched various animals, and cannot see that they make any use of the tuft of hairs upon the wrist for touching objects, except in the possible case of the Raccoon (*Procyon lotor*), which did appear to me to hold its food rather nearer to the wrist than is usual with animals. I believe that my two brief notes referred to are the first published statement of the *general* presence of this carpal tuft of hairs in mammals. Some years since, as I have already acknowledged, Mr. Bland Sutton described these hairs in various Lemurs[3], and showed plainly that they are a general character of that group, though they were wanting (and I can here confirm Mr. Sutton) in the Potto. I find, however, that in every group of animals, with the exception of the Apes, which use their front limbs as grasping-organs as well as for locomotive purposes, these structures are present with some few, though rather striking, exceptions.

Since the publication of the facts contained in those two papers, I have had the opportunity of examining a large number of mammals belonging to various Orders. I am therefore now in a position to extend the statements which I originally made, and to give more in detail the distribution of these curious structures in the group of mammals. I do not think that we have here a secondary sexual character, though it is possible that in some

[1] Vol. lxii. p. 523.

[2] "On the Anatomy of *Bassaricyon*," P. Z. S. 1899, p. 661.

[3] "On the Arm-Gland of the Lemurs," P. Z. S. 1887, p. 369; where they are figured in the genera *Hapalemur*, *Lemur*, and *Cheirogaleus*.

cases the male may be provided with the organ which is wanting in the female. I called the attention of the Society some little time since to the fact that the female of *Hapalemur simus*[1] has not this tuft, which is very plain and obvious in most Lemurs,

Text-fig. 17.

Left fore foot of *Dasypus villosus*; ventral surface.
H, tuft of vibrissæ.

including the male of the closely allied *H. griseus*. I have, however, met with the structure in too many females of different species of mammals to allow of its being regarded as a sexual

[1] "Notes on the Broad-nosed Lemur, *Hapalemur simus*," P. Z. S. 1901, i. p. 121.

character. Broadly speaking, it may be stated that this sense-organ, as we may in the meantime assume it to be, characterizes the Lemurs, Rodents, Carnivora, and Marsupials, and that it is absent in the Ungulates (with the exception of *Hyrax*) and in the Primates (excluding the Lemurs). The Bats I have not yet studied from this point of view. Of the Insectivora I am unwilling to speak, as I have examined only *Centetes* and *Erinaceus*, which certainly had not this tuft of hairs.

As to the Edentata, the representative of this carpal tuft of vibrissæ does appear to exist at least in the Armadillo, *Dasypus villosus*, as the accompanying figure shows (text-fig. 17, p. 128). But the hairs of that mammal are so coarse that there is but little difference in size and general appearance between the tuft which I compare to those of such an animal as *Petaurus sciureus* (text-fig. 18, p. 130) and the general hairs of the body. The Sloth (*Bradypus tridactylus*) has not any traces that I could discover of this "organ." As to other Edentates I have no information to offer, except concerning *Manis*, where I have found no traces of these hairs.

Considered broadly, therefore, this carpal tuft of vibrissæ is of some little use for classificatory purposes, apart from its absence in the Ungulates, where it might well be supposed to be deficient on account of the lack of facilities for use. The most salient feature as to its absence or presence is its nearly universal existence in the Lemurs, and the absolutely universal absence (as far as I have ascertained) in the Monkeys. These two divisions of the Primates, as they are most commonly considered to be, have been brought nearer to each other by recent researches upon certain extinct forms such as *Nesopithecus* [1], and by investigations upon the placenta of *Tarsius*, which has been shown to be ape-like and even human in its characters [2]. It is not, therefore, without interest to be able to bring forward a character which seems to absolutely distinguish these two divisions of the Primates. Furthermore, it is not a character which has an obvious relation to ways of life: if the tuft of vibrissæ is useful to the Lemurs, it would seem to be equally useful to the Monkeys, many of whom use their hands as climbing- and grasping organs in the same way. And I can at least assert, that while the majority of the Lemurs (excluding the Potto and the Loris) which I have examined possess this tuft, the large number of Monkeys, both of the Old and New Worlds, which have passed through my hands do not possess it.

As to the Marsupials, the genus *Macropus*, so far as my present investigations go, stands alone in that the wrist is not provided with this tuft of vibrissæ. I have examined both adults and quite newly born individuals of several species. In the naked new-born young of Marsupials this tuft of vibrissæ is exceedingly

[1] Forsyth Major, P. Z. S. 1899, p. 987.
[2] See, for a survey of the position of *Tarsius*, Earle, Amer. Naturalist, xxxi. p. 569.

obvious, and is nearly the only vestige of hair visible to the naked eye that the very young *Æpiprymnus*, *Potorous*, and *Phalangista* possess. But this carpal sense-organ is by no means confined to the Diprotodontia. I have found it in *Perameles* and in the Rat-tailed Opossum (*Didelphys nudicaudata*).

The Carnivora as a group are apparently characterized by the existence of this organ. I have found it in representatives of the Æluroidea (Domestic Cat, Lion, *Cynictis levaillanti*, *Herpestes*

Text fig. 18.

Right fore foot of *Petaurus sciureus*; ventral surface.
H, tuft of vibrissæ.

pulverulenta), the Arctoidea (*Putorius*, Otter, *Mustela*, the Coati), but I do not find it in the Dogs. There are, however, apart from the Dogs, some exceptions to its occurrence in the Carnivora. It certainly does not exist either in *Viverra civetta* or in *V. tangalunga*. Oddly enough, I could not detect the tuft of hairs in the Tiger, obvious though they are in the Lion.

The Rodents again are, as a rule, to be characterized by the

possession of this tuft of vibrissæ. Its presence is not, however, universal in this order of mammals. On the whole, I should be disposed to think that those Rodents whose feet have more of an Ungulate character, such as the Capybara and *Dolichotis*, are without the structure in question; but the majority of the genera which I have examined certainly are furnished with these long vibrissæ. I have found them, for example, in several species of *Sciurus*, in *Cricetus*, *Gerbillus*, *Microtus*, *Saccostomus*, *Acomys*, *Mus*, and *Pteromys*. It is remarkable that though they exist in

Text-fig. 19.

Right hind foot of *Petaurus sciureus*, lateral surface
H, tuft of vibrissæ.

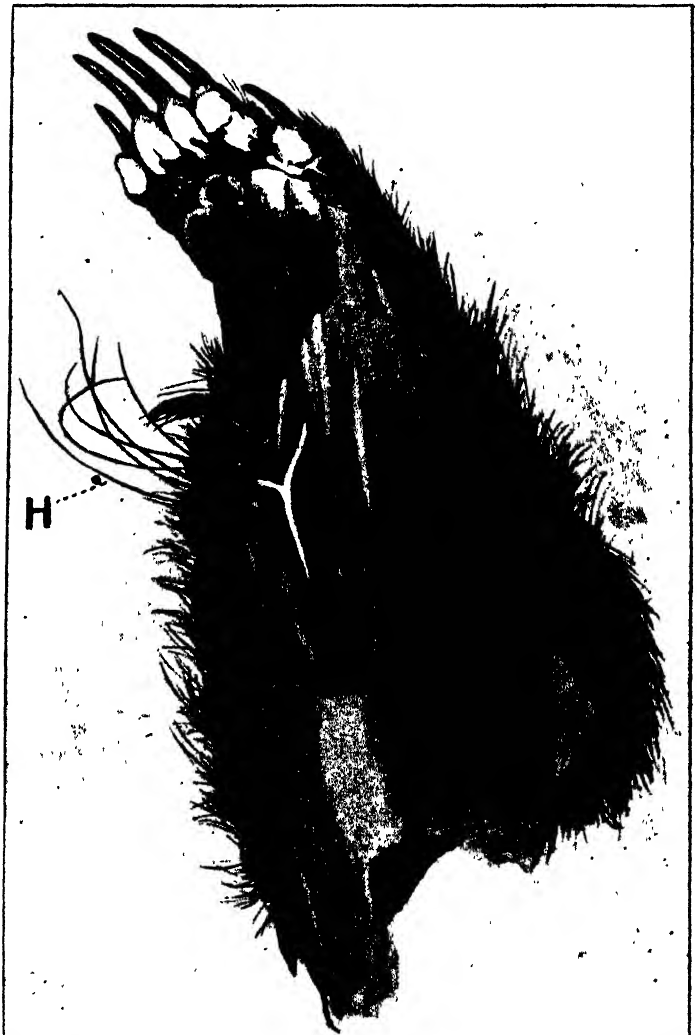
the Flying-Squirrel just mentioned, and I have had the opportunity of verifying their occurrence in two species, they are totally absent from the wrist of another genus of Flying Squirrel, viz. *Sciuropterus*. Nor can I find the tuft in the Jerboa or in *Rhizomys*.

Another peculiarity of this tuft of specialized hairs is that it is not invariably to be found in all individuals of a given animal. As a rule, so far as my experience goes, it is the case that the tuft is constant and to both sexes. But in the Suricate I have found

the tuft absent in one example, a male, and present in a second of the sex of which I have no record.

In all the cases that have been referred to in the above brief

Text fig. 20.



Left fore foot of *Nasua narica*; ventral surface.
Dissected to show nerve (N) supplying tuft of vibrissæ (H).

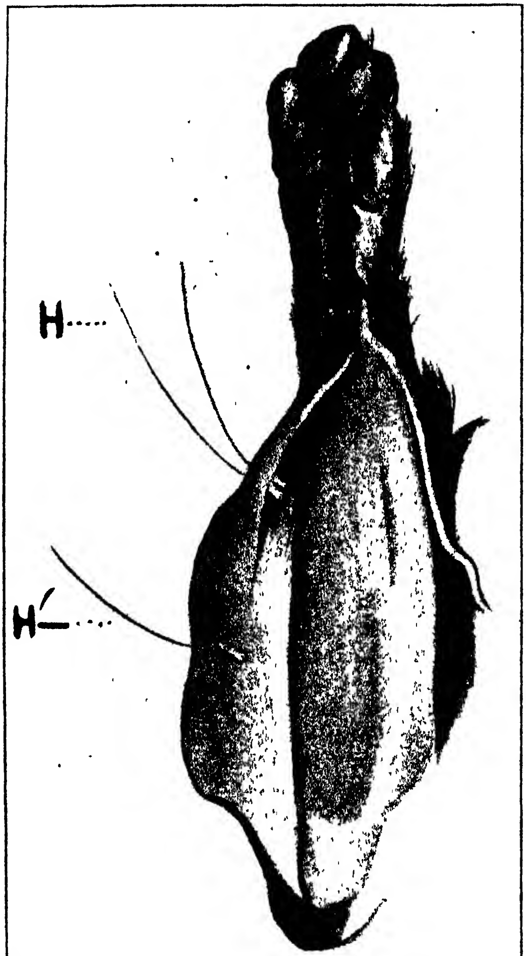
summary of the facts at my disposal, the vibrissæ were only to be found in the fore limbs. In some cases I admit I did not examine with great care the tarsus as well as the carpus. But after finding that in one species (illustrated in text-figs. 18, 19, pp. 130, 131) both fore and hind limbs showed a precisely similar tuft of vibrissæ, I naturally examined other animals that came my way. In *Petaurus sciureus*, in fact, this tuft of sensory hairs is present on both pairs of limbs, occupying a corresponding position in each. There was no difference that I could detect in the arrangement or structure of the vibrissæ in the two limbs. The case appears to me to be simply another instance of structures appearing in one pair of limbs being repeated in the other, just as the horny spine-like outgrowths of the wrist of *Hapalemur griseus* are found on the ankle of *Galago garnetti*[1].

The accompanying illustration (text-fig. 20, p. 132) shows the tuft of carpal vibrissæ in a Coati with the skin-flap removed and the muscles partly dissected. In this animal the tuft consists of six long black hairs, the implantation of which on the skin is shown in the drawing. The roots of these vibrissæ are provided with a nervous supply in the shape of a strong branch leaving the main nerve of the arm just opposite to the tuft, and ending after a short course without any sensible diminution of thickness and without any branching visible to the naked eye. This marked nervous supply to the carpal sense-organ is not, however, invariably found. The most aberrant condition of this carpal organ in all the animals which I have examined exists in *Hyrax*. In this Ungulate, the only Ungulate in which I have been able to detect the organ at all, I could only find it on one of the two fore limbs; and on that limb, the right, it was represented by only two long hairs, one being situated in the normal position which the tuft occupies in other mammals, and the other placed some way behind this. On carefully dissecting away the skin the roots of the hairs were exposed, and their great size enabled it to be seen that there were two of them, though only one hair was visible externally. In the case of the posterior tuft I could find but one hair-bulb. This state of affairs is shown in the drawing exhibited herewith (text-fig. 21, p. 134). The most careful examination failed to show any nerve-branch supplying the roots of the vibrissæ. I have no doubt that minute microscopic threads exist; but there is nothing that can be detected with the naked eye to be seen: and I think that it could hardly have been overlooked. Now it appears to me that we have in this animal a case of commencing retrogression of the organ in question. It can hardly be denied that *Hyrax* stands at least nearer to the base of the Ungulate series than do the Perissodactyla or the Artiodactyla. Therefore it is not surprising to find in *Hyrax* traces of a structure that has entirely disappeared in the more specialized forms; and in effect

[1] See Beddard, P. Z. S. 1884, p. 393, and ibid. 1901, vol. i. p. 272.

this appears to me to be the case. In *Hyrax* there is still a considerable trace of the carpal sense organ, present (?) in the ancestral Ungulates, which had not completely left off the use of

Text-fig. 21.



Left fore foot of *Hyrax*; ventral surface.
H anterior, H′ posterior vibrissæ.

their fore limbs as grasping-organs; but it is evidently undergoing degeneration, and has finally disappeared in the newer forms of Ungulates. At least it has disappeared, so far as my

observations go, in the form which it possesses in the Carnivora, Marsupials, &c.

But I shall now proceed to urge some facts and suggestions which would tend to show that in the Horse tribe there are traces of this organ present in the well-known "chestnuts" of those animals - callosities on the fore and hind feet or fore feet only. And to do so I must revert to the Armadillo. The condition of this organ in the Armadillo requires some further description, as it differs in certain points from what is to be found in other mammals. As will be seen from the drawing (text-fig. 17, p. 128), the long vibrissæ are not so markedly longer than the hairs which clothe the skin generally as is the case with other mammals. The general hairy covering of the Armadillo is coarse. In the second place, they are decidedly more numerous and not arranged in a tuft; they do not, that is to say, apparently spring from the same circumscribed spot. On the contrary, they are borne upon a raised patch of integument which is about half an inch long; this tract of integument, moreover, is considerably thickened, which marks it off from the surrounding integument in a very distinct way. A dissection of the skin in this region shows a nerve supplying this tract of vibrissæ covered skin; but the nerve is rather small in proportion to its bulk in such an animal as the Coati (text-fig. 20, p. 132). The tract of skin bearing the vibrissæ would be quite obvious if it bore no vibrissæ at all. It has, too, a hard "feel." Now if this specialization of the pad bearing the vibrissæ were to proceed further, it would become a mere horny pad and the vibrissæ would cease to grow upon its general surface, as with the pads of the foot. They would, so to speak, be driven off or at least to one corner. The resulting state of affairs would be such as is represented in the Lemur, where (*Lemur catta*) there is a horny pad, to the side of which is the tuft of carpal vibrissæ; a still further specialization would of course bring about the conditions which I and Mr. Sutton have shown to obtain in *Hapalemur griseus*. On the other hand, the disappearance of the tuft of vibrissæ would result in a structure precisely like the "chestnut" on the fore limbs of the Equidæ. It appears to me that the condition of the sensory organ upon the wrist of *Dasypus villosus* distinctly suggests a possible origin for the "chestnuts" of the Horse tribe, which have been variously explained, but not in this way. There is every *a priori* likelihood of finding traces in the Ungulata of this widely spread organ, and, as already stated, in the primitive ungulate *Hyrax* they actually exist, in a but slightly modified form. The difficulty caused by the fact that the hind limbs in the true Horses have also "chestnuts" is removed by the occurrence in *Petaurus sciureus* of these organs on the hind as well as on the fore limbs[1].

[1] It must be borne in mind, however, that in the horse the "chestnuts" of the hind limb are upon the ankle, those of the fore limb above the wrist. The latter position is that of other mammals.

It may be convenient to sum up the facts which have been detailed in this communication, and to present them in the form of a brief *résumé*:—

(1) In nearly all the Orders of Mammalia—viz., the Primates, Carnivora, Ungulata, Rodentia, Edentata, and Marsupialia—there is generally a tuft of strong vibrissæ upon the wrist.

(2) This tuft consists of from one to about twenty hairs usually (if not always) supplied by a strong nerve which arises from the radial nerve of the arm.

(3) This structure is as a rule, when present, found in both sexes; but occasionally it is present in the male only.

(4) The tuft of carpal vibrissæ is apparently absent from all the Ungulates, except *Hyrax*; and from the Anthropoidea among the Primates.

(5) In the groups where the carpal organ is present, it is apt to be capricious in its distribution. Thus it is present in the Lion, and absent in the Tiger.

(6) With the marked exception of the Anthropoidea, there seems to be a certain relation between the presence of the tuft of carpal vibrissæ and the nature of the fore limbs. When the fore limbs are purely ambulatory limbs, the carpal vibrissæ are absent.

March 4, 1902.

W. Bateson, Esq., F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of February 1902:—

The registered additions to the Society's Menagerie during the month of February 1902 were 73 in number. Of these 24 were acquired by presentation and 49 were received on deposit. The total number of departures during the same period, by death and removals, was 154.

Amongst the additions attention may be specially directed to:—

(1) A young male Snow-Leopard (*Felis uncia*), from Ladakh, presented by Capt. H. I. Nicholl, of the 1st Bedfordshire Regiment, Mooltan. We are much indebted to Capt. Nicholl for the care and trouble which he has taken in sending us home this rare and beautiful animal, of which so few specimens have ever reached us, and to Messrs. Gellatly, Hankey, & Co. for its passage home in the s.s. 'Prome.' It was originally obtained by Capt. Nicholl in Ladakh about September 1901[1].

(2) A pair of Prjevalsky's Wild Horses (*Equus prjevalskii*), being part of the same convoy as those lately acquired by His Grace The Duke of Bedford, our President, as was recently announced (see P. Z. S. 1901, vol. ii. p. 505).

Mr. Hagenbeck has supplied me with the following information respecting the capture of these animals:—

The Wild Horses were captured in three different districts in the vicinity of Kobdo in Western Mongolia (in about 38° N. and 90° 35′ E.), in the Chinese Empire, as shown on the map which I now send.

From Kobdo the horses were taken to the Siberian Railway Station, Ob. They were thirty-nine days on the way, including four days of travel by barges on the River Ob.

The Prjevalsky's Horses drop their young ones from the latter days of April to about the 20th of May, and during this time they come to particular spots, which are marked on the map, and they find at these places plenty of food and water.

The system of catching them is the following:—Large troops of Mongols hunt in combination, waiting for the animals behind the hills, and when they observe that a great many are together they all, on a signal, suddenly start and ride after the animals. As the young ones cannot follow their mothers, they are caught with nooses that are arranged on long sticks. The captives are brought to the camp, where the Mongols keep a lot of common mares with their young ones. These young ones are then taken away, and the wild colts put to the common Mongol horses to be nursed by them. After a few days the young ones become

[1] See 'The Field' of 1902 (vol. xcix. p. 325) for an account of the capture of this animal.

well acquainted with their nurses and then follow easily up to Kobdo.

I exhibit a water-colour drawing (Plate XIII.) by Mr. Smit, taken from two of the specimens now in the Gardens, which gives a good idea of the general appearance of Prjevalsky's Horse in its winter dress.

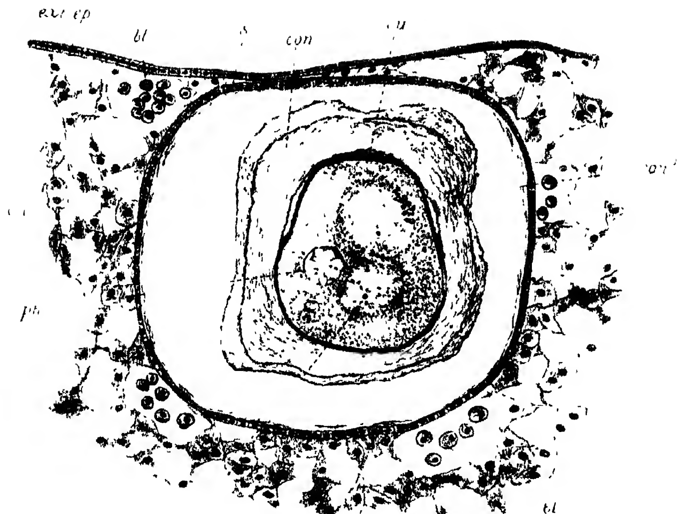
Mr. B. Tegetmeier, F.Z.S., exhibited a series of photographs of Prjevalsky's Horse, taken on different occasions, and stated that further information on the subject would be found in 'The Field' of January 11th (vol. xcix. p. 69, 1902).

Mr. E. N. Buxton, F.Z.S., exhibited a series of photographic slides illustrative of bird- and animal-life on the White Nile, which he had lately visited. He called attention to the enormous abundance of aquatic birds and waders which resort to the mud-banks of the Nile south of Khartoum and to the numerous lagoons in the marshes in the neighbourhood of Fashoda. Portraits were shown of Pelicans, Sacred Ibises (worshipped by the Egyptians of the early dynasties, but not now found in Lower Egypt), and many other birds—such as White Ibises, Black Ibises, Buff-backed Herons, Jabirus, Cranes, Stilts, Fish-Eagles, Goliath Herons, and Marabous. These had been secured by the use of a telephone-lens (by Dallmeyer), as also portraits of the Water-buck, the White-eared Cob (*Cobus leucotis*), the Tiang (*Damaliscus tiang*), and the Hippopotamus. The difficulties of making an approach to these wild animals for photographic purposes were described. Some characteristics of the Roan Antelope (*Hippotragus leucophæus*) were pointed out, and the habits of the Buffalo of the Nile and of the Reed-buck (*Cervicapra bohor*) were explained. Mr. Buxton expressed the opinion that the habit of the natives of burning the grass on the marshes affected the coloration of the White-eared Cob. The variation in colour of individuals of this species was illustrated by two heads of old males, and a skin of another individual was exhibited showing a white spot on the withers resembling that found in Mrs. Gray's Water-buck (*Cobus maria*).

Pictures were also shown of village-life among the Dinkas—a race of remarkable stature which inhabit the southern part of the Ghezireh.

Mr. G. T. Bethune-Baker, F.Z.S., presented a paper, entitled "A Revision of the Amblypodian Group of the Butterflies of the Family Lycænidæ," and made the following remarks:—

This important section of the Lycænidæ is broadly confined to the Indo-Malayan region, though a few species are found in China, Japan, and Queensland, and a few have also been recorded



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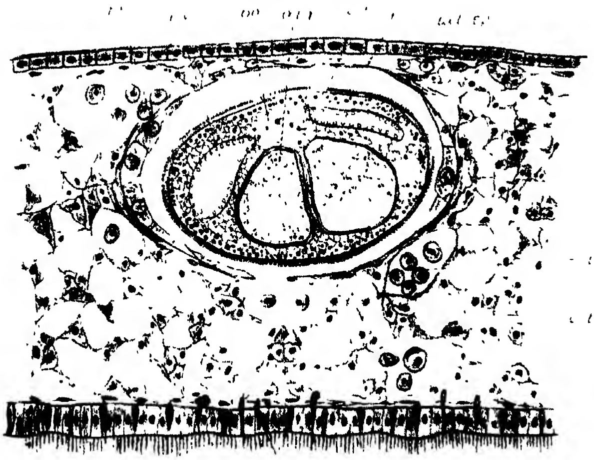

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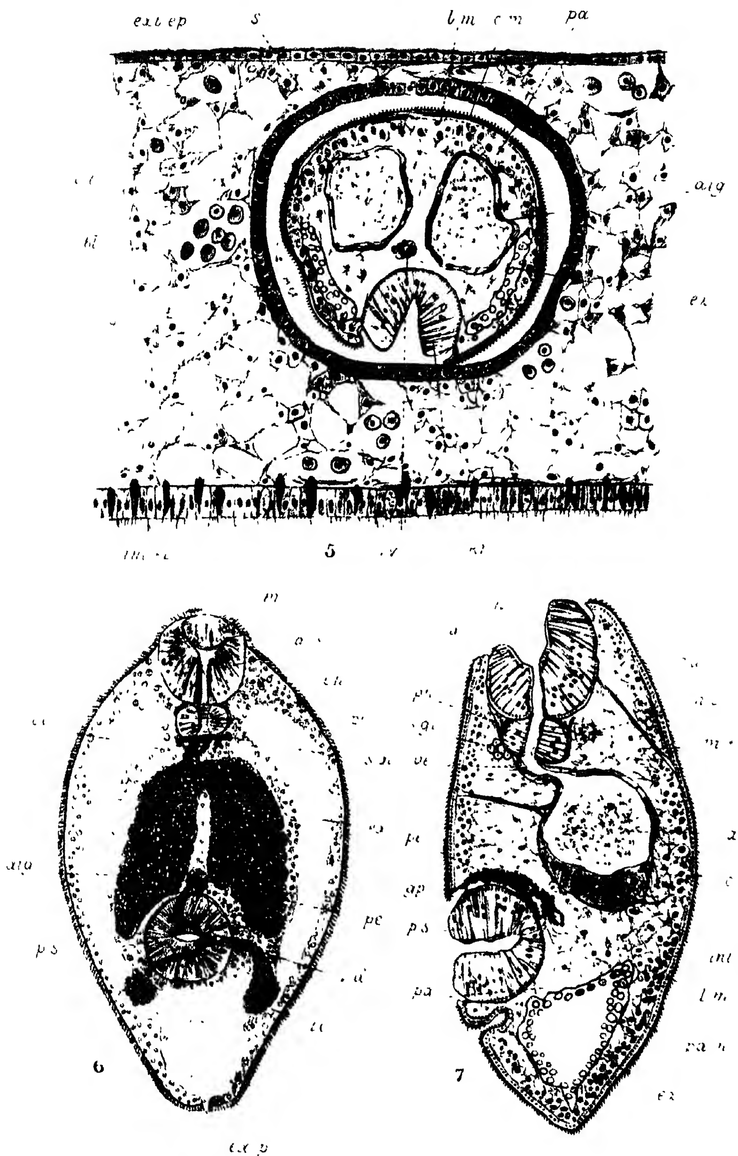
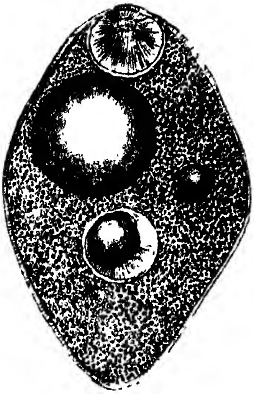
JAMESON ON THE ORIGIN OF PEARLS.



JAMESON ON THE ORIGIN OF PEARLS



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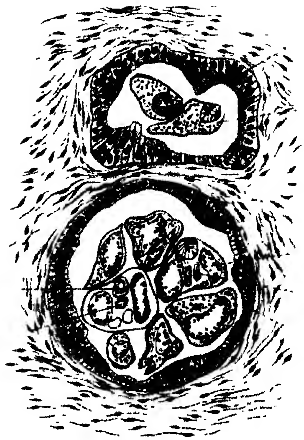

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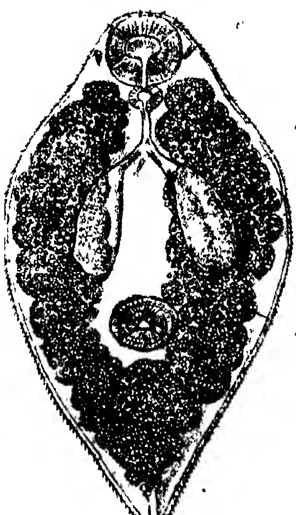

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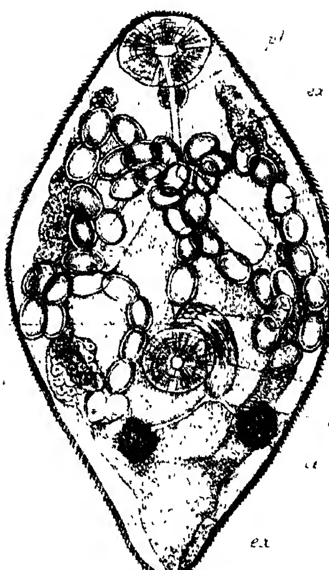

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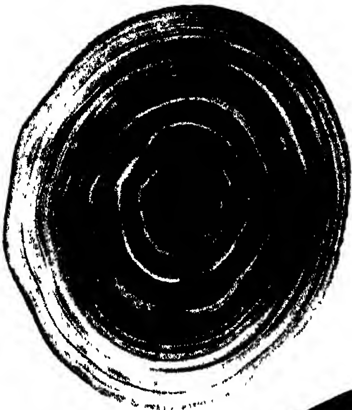
JAMESON ON THE ORIGIN OF PEARLS



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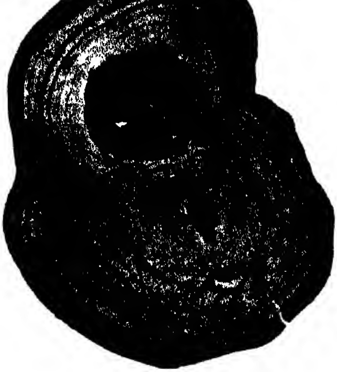

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JAMESON ON THE ORIGIN OF PEARLS

It has had many supporters, and still maintains a prominent position in zoological text-books and popular compilations. It is doubtless largely due to a confusion of true pearls with "blisters" or pearly excrescences on the shell. There is no recorded instance of an undoubted sand-grain having been found in a pearl, although hundreds have been examined. All attempts to produce pearls by introducing such bodies into the tissues or between the shell and mantle have led, at best, only to the formation of "blisters." Such methods of obtaining the latter have long been known to the Chinese, and have repeatedly been applied in other countries. Chemnitz, Beckmann, and others (1791) regarded Linnæus's "secret process" as merely boring the shells. However, no subsequent boring experiments have yielded anything but blisters, and the popular notion of Linnæus's *modus operandi* is little more than a guess. A great step in the right direction was made when Filippi, in 1852, discovered the connection between pearls and the presence of *Distomum duplicatum* in *Anodonta.* Filippi regarded these Trematodes as encysted. In his later papers he allowed other forms such as *Atax ypsilophorus* to be occasional causes of pearl-formation. He recognized that the action of these parasites was specific, and compared it to the formation of plant galls. Küchenmeister (1856) associated pearls in *Margaritana margaritifera* with the larvæ of *Atax ypsilophorus* van Beneden, which occur in the mantle, enclosed in cysts secreted by the mollusc. He held that other parasites, as well as bodies of internal origin, might also cause pearls.

Möbius (1857) found Trematode remains in pearls from the Pearl Oyster of the West Coast of America (probably *Margaritifera margaritifera* L., var. *mazatlanica* Hanley[1]). Kelaart (1859) held that parasites played an important part in pearl-formation in *Margaritifera vulgaris* (Schumacher) in Ceylon, but did not associate any definite organism with it, although he found several species living in the Pearl-Oyster. Thurston (1894) confirmed the existence of platyhelminthan parasites in the same species, but did not assert that they had anything to do with pearl-production. Garner (1871) found that pearls in *Mytilus edulis* and *Margaritana margaritifera* were due to Distomids, against which the molluscs protected themselves by coating them with calcium-carbonate. Comba (1898), who claims to have discovered a method of producing free pearls by artificial means, says (p. 6) that the cause is "un parassito il quale viene dal mollusco avviluppato di strati di una bava che indurendosi forma la perla formando così una pustola ed una pallina che cresce in grossezza."

Dubois (1901) found in *Mytilus edulis* that the production of pearls was due to Distomid larvæ, to which (without description) he applied the name *Distomum margaritarum.* His account of the "*désagrégation*" of formed pearls, and the liberation, to repeat their life-cycle, of the parasites that form their nuclei, is quite at

[1] For revised nomenclature of the Pearl-Oysters, see Jameson, 1901.

variance with my experience; and apparently presupposes that the Trematode can survive complete calcification, which would indeed be a very remarkable biological phenomenon. According to Dubois it is only certain pearls that, by the death of the *Distomum*, escape this annual disintegration and so reach greater dimensions.

Von Hessling (1858), it seems, was the first to ascertain that the pearl is formed inside an epithelial sac, and he emphasized the importance of this structure. He regarded the sac as being derived from the blood-cells.

This sac has been noted by Diguet (1899), who suggests that it may be due to the stimulation of a parasite. I can find no support for Diguet's view, that the formation of the pearl in this sac proceeds on different lines to those on which the substance of the shell is deposited.

The "vesicle or bag of the ovum" figured by Home (1826, pl. xiii.) may also be this sac.

Before entering upon an account of my own observations, I wish to express my thanks to Mr. H. H. Arnold Bemrose for kindly preparing the microphotographs which accompany this paper; to Baron Louis d'Hamonville for much valuable information concerning the pearl-bearing mussels of Billiers; to Mr. A. Scott, of the Lancashire Sea-Fish Hatcheries, for supplying me with abundant material from the Piel mussel-beds; and to Mr. W. Wells, Marine Superintendent at the Brighton Aquarium, for conducting experiments for me.

The distribution of pearl-producing individuals of *Margaritifera margaritifera* L., *M. marina* Jameson, *Pinna nigrina* Lam., *Hippopus hippopus* L., and *Tridacna gigas* Lam., in New Guinea and Torres Straits, suggested to me that pearls were the result of a specific pathological condition, and that the circumstances necessary to ensure infection were present only in certain areas, often of small extent. I soon convinced myself, by a study of material that I brought home with me, that Trematodes formed the nuclei of some of the pearls in each of the above-named species, but that others contained nothing more than a few yellowish granules in the centre. The same results were obtained with specimens of *Mytilus edulis*, sent me from Lancashire by my friend Mr. James Johnstone. In all cases where the pearls had been preserved *in situ* in the tissues, they were found to be enclosed in a sac composed of an epithelium physiologically and histologically identical with the outer shell-secreting epidermis of the mantle. This observation at once accounted for the similarity in structure between the layers of the shell and those of which a pearl is composed. The obvious conclusion was that ***this sac is the direct, and the Trematode the indirect, cause of pearl-production***, and that the key to the problem of the origin of pearls might be obtained by investigating the origin of the sac and its relations to the Trematode.

As it was not possible for me to return to the habitat of the true Pearl-Oysters, I selected the Common Mussel (*Mytilus edulis*) as a suitable species upon which to begin my observations. This mollusc produces pearls in many localities on the coasts of Europe, but it is only on certain beds that pearls are abundantly formed. The most favourable places seem to be estuaries or land-locked channels. In such situations pearls may be found in almost every example, except those which are attached to stakes or floating objects, and so raised off the bottom.

The pearls produced by the Common Mussel are, like the nacreous lining of the shell, lacking in lustre. They are generally white or silvery, but blue and brown examples are not uncommon. They have no value as gems, though, strange to say, a market seems to have existed for them in the first half of the last century ("D. C.," 1830).

They are mostly formed in the subcutaneous tissue of the dorsal body-wall or in the mantle-lobes. When they occupy a more deep-seated position they have probably been secondarily displaced.

In the little harbour of Billiers (Morbihan), situated on the estuary of the Villaine, there is a colony of pearl-bearing mussels, that has been described by d'Hamonville (1894). After reading d'Hamonville's account, I was struck with the idea that this colony should offer special facilities for investigating the causes of pearl-formation and the conditions for infection. D'Hamonville found that although the mussel is abundant all round the coast, pearls are only produced in the harbour itself, the beds being, at most, only a few acres in extent. Here almost every shell, if not too young, contains pearls.

I visited Billiers in August 1901 and again in December of the same year, and had no difficulty in finding the parasites and tracing the part played by them in pearl-formation. They were the larvæ of a Distomid belonging to the subgenus *Leucithodendrium* (Loos), and very closely resembling *L. somateriæ* (Levinsen), which in the mature condition inhabits the intestine of the Eider Duck. I found larvæ, very similar to these, in Sporocysts in *Tapes decussatus*, and subsequently proved the infection of *Mytilus* experimentally from these Sporocysts. In September of the same year I visited Piel, Lancashire, and found that there also pearls are caused by the same parasite, but that in this case *Cardium edule* acts as "first host" for the Sporocyst.

Finally, in December 1901, when I revisited Billiers, I examined five specimens of the Common Scoter or Black Duck, *Œdemia nigra* L., which is notorious in the Villaine for its depredations on the mussel-beds, and is locally called, on account of its habit of feeding on *Mytilus*, "Cane moulière." Every one of these specimens was teeming with *Distomum* (*Leucithodendrium*) *somateriæ*.

For histological work, pearls were decalcified *in situ* in the tissues and then sectioned. Others were decalcified, cleaned, and

examined whole; while others again were ground down on a Water-of-Ayr hone, care being taken that the "Schliff" so made should pass as nearly as possible through the centre. The *Cercariæ* and Sporocysts were either examined entire, or sectioned *in situ*.

For decalcifying, it was found best to use pearls preserved in spirit, as those that had been kept in a dry state, although often giving good results when examined entire in oil of cloves, were unfit for cutting with the microtome, owing to the brittle and horny nature of the dry conchyolin. The most satisfactory effects were obtained by using very dilute (·5 to 1 per cent.) nitric acid in water. Stronger solutions often caused bubbles of carbon dioxide to be evolved in the residual conchyolin, but by using these weak solutions freely the gas was dissolved almost as soon as formed. The time required for this process varied from a few days to some weeks, according to the dimensions of the pearl and the proportion of conchyolin to salts.

Structure of the Mantle and Shell.

The tissues composing the mantle of *Mytilus edulis* are:—

(1) An external simple epithelium, which is a direct continuation of the dorsal body-wall;
(2) An internal ciliated epithelium, resembling the epidermis of the foot and gills; and
(3) A spongy connective tissue, in the meshes of which the blood circulates.

The external epithelium (Pl. XIV. figs. 1–4, Pl. XV. fig. 5, *ext.ep.*, and text-fig. 22) is composed of a single layer of flattened columnar cells with spherical or ovate nuclei. The outer surfaces of these cells are closely applied to the inner nacreous substance of the shell. The appearance of this epidermis differs considerably according to the degree of contraction and method of preservation. Its constituent cells are polygonal in surface view, and brick-shaped or columnar in sections at right angles to the surface.

Their protoplasm stains rather more strongly with hæmatoxylin than that of the connective tissue, and shows faint striæ perpendicular to the surface. Their bases are attached to the connective-tissue fibres. Scattered here and there throughout this epithelium are spherical cells which stain lightly. They may be the "Eirund körnige Zellen" that Tullberg describes (1882). They are never numerous, and I am inclined to attribute their presence largely to defects in preservation.

The epidermal lining of the mantle-cavity (Pl. XIV. fig. 2, Pl. XV. fig. 5, and text-fig. 22, *int.ep.*) is the typical glandular ciliated epithelium so common in the skin of invertebrates. It is composed of columnar ciliated cells and interstitial gland-cells, some of which project basally into the connective tissue. It is

altogether a much more heterogeneous layer than that applied to the inner surface of the shell, and is usually rather thicker.

The connective tissue (Pl. XIV. figs. 1–4; Pl. XV. fig. 5, *c.t.*) is a meshwork of irregular or stellate cells with oval or spindle-shaped nuclei, and more delicate fibres the nuclei of which are relatively longer and narrower, and stain more deeply than those of the former. There is a perfect intergradation between the two kinds of cells, and their relative abundance varies in different individuals according to the condition of the gonads. The fibres are more numerous just under the epidermis than elsewhere. The blood circulates in the spaces between these cells and fibres, and in places these lacunæ are enlarged to form regular blood-sinuses. Numerous blood-corpuscles (*bl.*) can be seen in the meshes of the connective tissue, especially under the outer and inner epidermal layers.

Yellow refractive granular masses, showing traces of cellular structure, sometimes occur in the meshes of the mantle parenchyma, especially in old mussels. These may be the remains of the broken-down gonads of previous years, or groups of dead leucocytes.

In the connective tissue are embedded the nerves and muscle-fibres of the mantle, and the gonads when ripe extend into it.

The structure of the shell has been very thoroughly investigated by von Nathusius Königsborn (1877), Tullberg (1882), and Ehrenbaum (1885), to whose observations I can add nothing new.

The method in which the shell is laid down is of great interest on account of the identity in structure between the substance of pearls and that of the shell. Biedermann's recent paper (1901), which is full of new and significant facts and carefully summarizes previous observations, proves beyond all question that the organic basis of the shell (conchyolin), which is present also as the basis of pearls, is a true cuticular product, secreted or excreted by the underlying epidermis of the mantle. Biedermann shows that in both Lamellibranchs and Gastropods the calcareous substance of the shell *can only be deposited in such a cuticle.*

The cuticular conception of the conchyolin was, I believe, first propounded in this form by Huxley (1859). In sections of the decalcified shell and mantle, I find that the epithelium is generally applied closely to the conchyolin, and its cuticular outer surface is apparently directly continuous with the latter. If, during the process of fixing, the mantle has been separated from the shell, a certain amount of uncalcified conchyolin may be found attached to the epidermis. Moreover, if the mantle of a live mussel be carefully stripped from the inner surface of the shell, a delicate transparent membrane, like that which Huxley found in *Anodonta*, but less conspicuous, can be detected. This membrane tears away irregularly, some parts adhering to the mantle, others to the shell. This irregular tearing is a further evidence that the uncalcified membrane is in continuity with both shell and mantle. That the mantle can, however, detach itself from the inner surface of the

shell is obvious in such forms as *Margaritifera*, *Pinna*, and *Tridacna*, where the mantle-margin is freely retractile.

The evidence adduced in support of the alternate theory of growth by intussusception, originated by Mery (1712), revived by von Nathusius (1877 & 1898), and supported by Felix Müller (1885), is not convincing. The facts supposed to lend weight to this hypothesis are quite explicable on the apposition theory.

Pearls, Blisters, and Concretions.

As some confusion exists as to the exact connotation of the word pearl, I propose to adopt in this paper the terms "pearl," "blister," and "free concretion" for three different kinds of structures that occur in molluscs.

Pearls.—A pearl consists of one or more layers of shell-substance (*i. e.*, conchyolin in which the crystals of inorganic matter are disposed in the same manner as in the shell), enclosing a central nucleus, and formed in a closed sac embedded in the tissues. This sac is composed of epithelial cells similar to those that form the outer mantle-epidermis. This sac is first formed around a parasite, which probably exercises a specific stimulation.

In *Mytilus edulis* and many other forms this parasite is a larval Trematode, but it is probable that certain other parasites can stimulate some molluscs to form such sacs. The parasite does not necessarily become the nucleus of the pearl, but may escape from the sac before calcification.

Any of the substances which form the different parts of the shell may be represented in a pearl. Thus we have nacreous pearls, prismatic pearls, the periostracum pearls of *Modiola modiolus* formed in the mantle-margin, pearls a part of which may be formed of the transparent striated substance which characterizes the attachment of the muscles to the shell, and pearls formed entirely or in part of the substance of the hinge-ligament. Large brown leathery hinge-pearls are occasionally found in Torres Straits in *Margaritifera maxima* Jameson.

A pearl may become secondarily fused to or embedded in the substance of the shell by the absorption of intervening tissues (text-fig. 22). These pearls are sometimes spoken of as attached pearls. Similarly two or more pearls may become fused together, forming double or compound pearls, of which a notable example is the celebrated "Southern Cross."

The various substances, when two or more are present, are not always arranged exactly in the reverse order of the layers of the shell, as sometimes stated. We may, indeed, have several alternations of nacre and prismatic substance, or of the latter and conchyolin. The kinds of shell-substance entering into the composition of a pearl are determined by the position of the latter. De Villepoix (1892) has shown that different parts of the mantle-epithelium are concerned severally in the formation of periostracum, prismatic and nacreous substance. Obviously the

epithelium of the pearl-sac acquires the special characters of the adjacent part of the epidermis.

Blisters.—It is proposed to confine this term to internal excrescences of the shell, which are caused by the intrusion of foreign bodies between the mantle and the shell, or by the secretion of a nacreous cicatrix to close the perforations of boring molluscs, worms, or sponges. These are sometimes referred to as "attached pearls" or even as "pearls," but have a totally different mode of origin and should never be confused with the latter.

Concretions.—In many molluscs small free calcospharitic bodies occur at times in the connective tissues, which, not being enclosed in epidermal sacs, cannot acquire the structure of the shell-substance. They are probably due to different causes in different molluscs. In *Tapes* they are frequent, and are due to the calcification of degenerated Sporocysts or of dead Cercariæ contained in the same. Similar concretions, which I found in *Pholas candida* at Billiers, were caused by dead Cercariæ of another species, contained in Sporocysts.

Old examples of *Mytilus edulis* L., *Modiola modiolus* L., *Hippopus hippopus* L., *Margaritifera vulgaris* (Schumacher), and *Anodonta* sometimes contain similar bodies, but their origin in these cases is uncertain.

In all instances that have come under my notice they are more or less spherical, and composed of needle-like prisms of carbonate of lime radiating from a centre.

Structure of Pearls.

A *Mytilus*-pearl examined entire often shows a darker spot in the centre, which corresponds to the "nucleus." The nucleus is always visible in a section ground from the pearl, though its size varies from ·1 mm. to ·7 mm.

It is often yellowish brown or black, the colour being imparted by the dead remains of the Trematode, or by the small amount of residual matter left, if the worm has escaped from the sac (Pl. XVII. figs. 12–16). The crystalline structure of the nucleus is quite different to that of the remainder of the pearl and to that of the shell. We find in the nucleus one (Pl. XVII. fig. 16) or more (Pl. XVI. fig. 8, Pl. XVII. fig. 14) centres of calcification, consisting of spherical masses of radially arranged crystals. Each centre of calcification, if more than one be present in the nucleus, shows a distinct black cross when viewed between crossed nicols. Sometimes the nucleus is irregularly or incompletely calcified (Pl. XVII. figs. 14–16). The resemblance which concretions and the nuclei of pearls bear to *Harting's bodies* (Harting, 1872) is interesting; for they are formed, so far as we can judge, in a similar manner, namely, by the slow precipitation of carbonate of lime in a viscous substance like albumen or decaying animal matter. On the other hand, the peripheral parts of the

pearl are, like the shell, formed by the calcification of the cuticle of the living cells, and owe their structure to the special characters of that membrane or of the underlying epidermis.

A section of a decalcified pearl shows the nucleus, in which the cuticle and sometimes the suckers of the *Distomum* can be distinguished. Occasionally the outlines of the soft parts (*e. g.*, pharynx and digestive cæca) are still visible, as in Pl. XIV. fig. 1, *ph.* & *dig.* More generally, however, nothing can be seen but a mass of yellowish-brown granular substance surrounded by the cuticle (text-fig. 22).

There is often a certain amount of refractive granular matter associated with the remains of the worm, probably an excretion; and, if the parasite migrates out of the sac, this may form the inconspicuous nucleus of a pearl.

Just as the peripheral parts of a pearl present, when ground down to a thin section, a similar structure to that of the shell, so the conchyolin basis of a decalcified pearl shows the same characters. The outermost layer of the latter is uncalcified and continuous with the cuticle of the cells of the sac, just as the outer mantle-epidermis is attached to the inner surface of the shell (Pl. XIV. fig. 1, *con.'*).

There is no organic union between the conchyolin and the nucleus.

The sac containing the pearl is composed of a simple columnar epithelium (Pl. XIV. fig. 1 & text-fig. 22, *s.*), which in its histological structure, as well as in its power of secreting as a cuticle the conchyolin basis of the pearl, is indistinguishable from the outer epidermis of the mantle.

Blood-spaces, containing corpuscles, are well developed around the sac.

Such a pearl cannot then be compared—as some writers have suggested—with the concretions or calculi of cholesterin or other substances found in the vertebrate body, but rather with the structures sometimes found in epidermoid tumours and atheroma cysts.

Origin and Development of the Pearl.

The Trematode enters *Mytilus edulis* as a tailless Cercaria, and at first may often be found between the mantle and shell. It is probable that it reaches this position by boring through the mantle, but I have not yet been able to find one in the act of doing so. The larvæ creep about on the inner surface of the shell, and, after a while, again enter the connective tissue of the mantle, where they come to rest, assuming a spherical form. They seem to avoid the more muscular parts of the mantle—no doubt because the absence of a definite boring apparatus makes it difficult for them to pass through the latter. When embedded in the tissues they are visible to the naked eye as little yellowish spots, about ½ mm. in diameter.

At first the worm only occupies a space lined by connective-

tissue fibrils (Pl. XIV. fig. 2), but soon the tissues of the host give rise to an epithelial layer, which lines the space and ultimately becomes the pearl-sac (Pl. XV. fig. 5, *s.*).

This epithelium appears to arise quite independently of the outer epidermis, and is no doubt due to a specific stimulation on the part of the parasite, as other parasites, *e. g.* Sporocysts, Cestode larvæ, &c., are not surrounded by such a sac.

At first a few cells appear (Pl. XIV. figs. 2, 3, *pr.*), which proliferate and arrange themselves along the walls of the cavity. These cells are larger than the connective-tissue corpuscles, and more susceptible to stains. They are flattened and polygonal in surface view. Their nuclei (Pl. XIV. fig. 3, *n.*) are large and spherical, and show the conspicuous chromatin reticulum and distinct nucleolus that characterize the nuclei of embryonic or rapidly dividing tissues.

I have not been able to find the nuclei of these cells actually undergoing division. The proliferating sheet of cells ultimately surrounds the parasite and becomes the sac. From the first these cells are basally continuous with fibres of connective tissue (Pl. XIV. fig. 3, *c.t.*). Their transformation into the pearl-sac is a gradual one, and every step can be traced in sections of the parasites *in situ*.

If the Trematode larva completes its maximum possible term of life it dies, and the tissues of the body break down to form a structureless mass, which retains the form of the parasite owing to the rigid cuticle.

In this mass arise one or more centres of calcification (Pl. XVI. fig. 8), and the precipitation of carbonate of lime goes on until the whole larva is converted into a nodule which has the calcospheritic structure already described for the nucleus. The granular matter surrounding the worm, if present, also undergoes calcification.

The epithelium of the sac then begins to shed a cuticle of conchyolin (Pl. XIV. fig. 1), and from this point the growth of the pearl probably takes place on the same lines and at the same rate as the thickening of the shell.

The sac sometimes begins to form pearly substance before the worm is completely calcified (Pl. XVII. fig. 16).

The Distomid larvæ sometimes leave the sac formed around them, and voluntarily migrate into other parts of the body before again settling down. Empty sacs may be found in the mantle, and old specimens of the larva (distinguishable from recently immigrated ones by their darker colour and laden excretory organs) sometimes occur free between the mantle and the shell.

The occurrence of pearls in which the nucleus is not a Trematode but merely a few refractive granules (Pl. XVII. fig. 13) can be accounted for in this manner.

Some compound pearls are evidently formed by short migrations on the part of the Cercariæ, which leave a small amount of

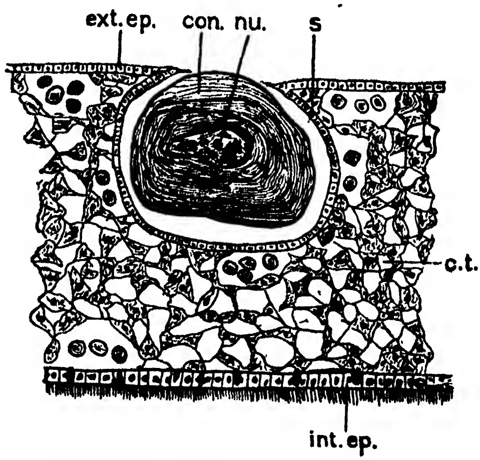
residual material in the sac, vacate it, and settle down in the immediate vicinity (Pl. XVII. fig. 15).

The residual matter in the first sac forms the nucleus of a pearl, and if the Trematode dies another is formed in the new one beside it. If these pearls grow and fuse a double pearl is formed, the nucleus of one half being obviously a Trematode, that of the other being merely granular matter.

I have traced three stages in the formation of such a pearl—the first, in which a Cercaria is found in a sac with a vacated sac close by; the second, in which a small pearl is close to the live Cercaria; and the third, in which two or more small pearls lie close together, only one having a Trematode for nucleus.

Dubois (1901) suggests that the death of the Distoma may sometimes be determined by Sporozoa, some members of which group are known to attack Trematodes. In one of the specimens that I sectioned there was a parasitic protozoon embedded in the tissues. If such parasites were to occur frequently they would of course facilitate and intensify the production of pearls. But they are not essential, any more than the presence of the dead Distoma in the sac is necessary for pearl-formation.

Text-fig. 22.



A Pearl about to become attached to the Shell.

nu., nucleus of pearl; *int.ep.*, internal ciliated epidermis of mantle; *ext.ep.*, external epidermis of mantle; *con.*, conchyolin basis of pearl; *s.*, epithelium of pearl-sac; *c.t.*, connective tissue. × 50.

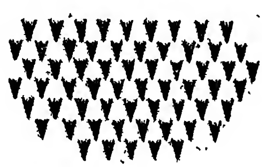
A pearl may increase in size until its diameter is considerably greater than the thickness of the mantle, so that it protrudes visibly. It may even break through the ciliated epidermis; for valuable pearls have been found in the branchial chamber and also outside the shells.

If it presses upon the tissues intervening between itself and the shell, these may become absorbed, in which case the epithelium of the pearl-sac becomes continuous with the shell-forming epidermis (text-fig. 22). The result is that the subsequently formed layers of the pearl are continuous with those of the shell, and an attached pearl is formed. The fusion of two or more pearls to form a compound pearl is effected in the same way.

Structure of the Trematode Larva.

With the exception of the female reproductive organs, which are as yet undeveloped, the larva presents all the characters of *Distomum* (*Brachycœlium* Dujardin, 1845, *Leucithodendrium* Loos, 1896) *somateriæ* (Levinsen, 1882), from the Eider Duck, Greenland. (For sub-classification of Dujardin's subgenus *Brachycœlium*, see Stossich, 1899.) The body (Pl. XV. fig. 6) is oval, blunter in front than behind, and tapering markedly in the last third. In the resting condition inside the sac it is nearly spherical. The average dimensions are ·55 mm. to ·7 mm. The extreme sizes seen were ·45 mm. and ·75 mm. The oral sucker is larger than the ventral one, the ratio of their diameters being usually about 4 : 3. But in this point there is a considerable amount of variation both in the larva and in the adult *L. somateriæ*. Except on the surfaces of the suckers, which are smooth, the cuticle is beset with small spines (text-fig. 23). These are arranged in transverse rows, the

Text-fig. 23.



Cuticle of the *Cercaria*, in surface view. × 700.

members of which also form diagonal rows, so that the cuticle in surface view appears to be divided up into little diamond-shaped fields. There are about two hundred transverse rows of spines on the dorsum. Immediately around the ventral sucker the spines occur in concentric circles. The connective tissue is the typical parenchyma of the Flatworms (Pl. XIV. fig. 2; Pl. XV. figs. 5, 7, *pa.*). It is richer in nuclei immediately under the skin than elsewhere, especially on the dorsal surface (Pl. XV. fig. 7, *pa.n.*). Some muscle-fibres are present in the connective tissue running from the body-wall to the suckers and pharynx (Pl. XV. fig. 7, *m.f.*). The musculature of the body-wall consists of an outer circular layer (Pl. XV. figs. 5, 7, *c.m.*) immediately under

the cuticle, a deeper longitudinal layer (*l.m.*), and, on the ventral surface, a less defined tract of transverse fibres inside the longitudinal muscular coat.

The suckers are lodged in a slight involution of the cuticle (Pl. XV. figs. 5, 7). Their relative and absolute sizes in surface view are determined by the degree of contraction of their constituent fibres. The ventral sucker is about one-fourth or one-third of the total breadth of the body.

The mouth is situated in the middle of the anterior sucker, and generally appears triangular in sections (Pl. XV. figs. 6, 7, *m.*). The funnel-shaped buccal tube opens behind, by a narrow orifice, into the spherical muscular pharynx (*ph.*). This is followed by the short straight œsophagus (*œ.*), which, passing upwards and backwards, bifurcates to form the sac-like digestive cæca (Pl. XIV. fig. 2; Pl. XV. figs. 5–7, *dig.*), which are dorsal to the other organs. In the resting worm these cæca are greatly distended with yellowish granular material, doubtless derived from the tissues of *Mytilus*.

Even the œsophagus is often tightly crammed with food. The digestive system in this condition occupies the bulk of the body, anterior to the ventral sucker, but when empty is much smaller. The posterior end of the pharynx is provided with a group of salivary glands (Pl. XV. figs. 6, 7, *s.gl.*). The epithelium of the digestive system consists of very large flat polygonal cells with conspicuous nuclei (Pl. XV. fig. 7, *int.ep.*). The individual cells can sometimes be distinguished in pressure preparations. There is an ill-defined supra-pharyngeal nerve commissure (Pl. XV. fig. 7, *n.c.*) and a pair of lateral cords. The excretory system (Pl. XIV. fig. 2; Pl. XV. figs. 5–7, *ex.*) consists of two enormous tubular sacs, extending to the anterior end of the body and converging to form a pyriform median vesicle, which opens by a pore at the hinder end (Pl. XV. fig. 6, *ex.p.*). The excretory tubes are generally quite full of opaque spherical granules, presumably of excretory matter. When treated with hydrochloric acid they become transparent (Pl. XV. fig. 6).

In living specimens a few flame-cells can be seen in short, lateral, and apparently unbranched tubules given off by the excretory sacs. But the distended condition of the latter makes it difficult to ascertain their precise relations.

The female organs are not developed in the resting larva. The worm is protandrous, and the male genital organs reach a conspicuous size, even in the Sporocyst. The rudiments of the testes, vasa deferentia, and penis are very obvious in sections (Pl. XV. figs. 5, 7) and in stained preparations of the entire worm (Pl. XV. fig. 6). Being composed of young cells they stain deeply. In fresh specimens they are less obvious. The penis opens out at the genital pore (Pl. XV. fig. 7, *g.p.*), which is situated immediately in front of the anterior border of the ventral sucker. It is an elongated hollow pyriform body, lying in front of and dorsal to the sucker. The rudiment of the

seminal vesicle receives the vasa deferentia (Pl. XV. fig. 6, *v.d.*), which can be traced back into the spherical testes (*te.*).

Biology.

When the larva first enters *Mytilus* it is somewhat smaller than the resting specimens and more transparent. The excretory organs, which are laden with granules while in the Sporocyst, are comparatively empty, and the gut is not yet distended with food. As it grows older both the excretory and digestive systems become more and more laden, so that they form the great mass of the body (Pl. XIV. fig. 2; Pl. XV. fig. 5). It is largely to the contents of the latter that the parasite owes its dark yellow colour, the cuticle being pale golden or straw-coloured.

The worm often excretes some granular substance, which may almost surround it in the sac. It is this stuff that serves as "nucleus" for a pearl, if the Trematode migrates to another part of its host.

It is interesting to note that at no period is this worm *encysted*, in the sense in which the Liver-fluke and so many other Cercariæ encyst. The dark colour of the epithelial sac, which can often be isolated with the worm, suggests, on casual observation, that the latter is encysted, but I have determined by sections that this is never the case.

In a certain sense it is a resting stage, but the distension of the alimentary system makes it obvious that it is also a highly assimilative phase in the life of the worm, which is storing up energy for the maturation of the gonads, on reaching the final host.

Life-history of the Parasite. The Sporocyst Stage.

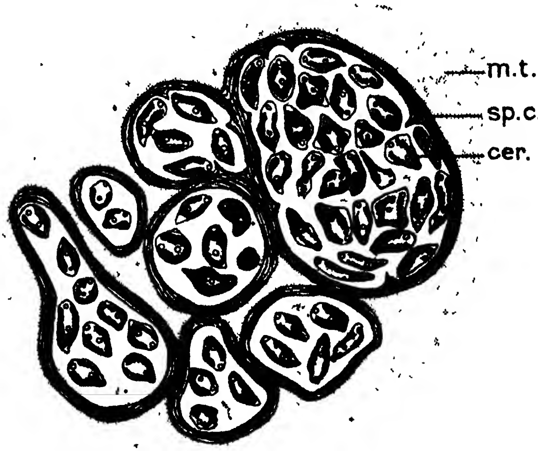
After a laborious examination of most of the organisms which inhabit Billiers Harbour, I was rewarded by finding, in *Tapes decussatus* Gmel., Sporocysts containing tailless larvæ, almost identical with those which occur in *Mytilus* (Pl. XVI. figs. 9, 10, and text-fig. 24). They differed from the latter only in their smaller size, paler colour, more distended excretory organs and empty gut, and in the possession of special sense-organs and eyes. *Tapes decussatus* is extremely abundant in Billiers Harbour, living in burrows about six inches deep in the black gravelly clay that forms the bottom. The local name of this mollusc is *Palourde*, and it is extensively collected for food. I am informed that although *Tapes* occurs in small numbers all along the shores of the Villaine, it is nowhere found in sufficient quantities to be worth fishing, except in Billiers Harbour. Indeed, when I visited Billiers in December 1901, a lugger from the other side of the estuary came over specially to collect this shell and *Mya arenaria* for the markets, there being no supply on the south shore.

I found Sporocysts in every specimen of *Tapes* that I examined, numbering nearly two hundred. They occur in the muscular or

connective tissue of the mantle-margin, where it is attached to the "pallial line," especially along the ventral border, and around the insertion of the siphonal musculature. The favourite place seems to be the dorsal side of the latter. The individual Sporocysts are embedded in and closely adherent to the bundles of muscle-fibres.

In young examples I found small, simple, spherical or oval Sporocysts, about ·5 mm. in diameter, and containing 6–10 Cercariæ, but in larger examples groups of Sporocysts occur (Pl. XVI. fig. 9, and text-fig. 24).

Text-fig. 24.



Tapes decussatus.

Group of Secondary Sporocysts, as seen in a pressure preparation.

m.t., muscular tissue of *Tapes*; *sp.c.*, Sporocyst; *cer.*, Cercaria contained in Sporocyst.

The individual Sporocysts in these cases are often larger than the simple ones. The groups are, from their position, their relations to one another, and their progressive increase in size and number of constituent cysts as *Tapes* grows older, evidently produced by budding or secondary division of the original simple ones. Their growth is very slow, and their duration of life must be practically co-extensive with that of their host. In large specimens of *Tapes* they appear to represent several successive infections; as we may have, in the same individual, large groups, probably several years old, smaller ones containing three or four cysts, and finally little single Sporocysts like those found in young individuals. On the other hand, in young *Tapes*, 10–20 mm. long, although the simple cysts and small groups occur, the large groups are not to be found.

Specimens of *Tapes* measuring 12 × 10 mm., with one marked *period* or interruption in the growth-rings on the shell, contained

small simple Sporocysts, or, at most, groups of three or four secondary ones. Examples which averaged 17–21 mm. in length contained masses of seven to ten cysts, those measuring 27 mm. had still larger groups, while from that size upwards there was a steady progression in the dimensions and number of constituent units in the groups of Sporocysts. Some of those found in *Tapes* 40-50 mm. long measured 7 mm. in diameter, and contained as many as thirty secondary cysts, and a hundred Cercariæ or even more.

As the Sporocyst grows, it sometimes compresses the tissues that intervene between it and the shell, which apparently interferes with the secretion of fresh shell-layers. This leads to the development of white chalky spots on the inner surface of the valve. These patches, in old individuals, further prove that the large groups of Sporocysts are the descendants of the original small ones which are present when the molluscs are young. For we may see two or more white scars on the lining of the shell, marking the position of the cysts when the shell was younger. In fact, the Sporocysts may leave, imprinted on the shell, the history of their movements as the mantle-margin shifts outwards, just as the adductor muscles mark on the nacre the record of their migrations. The first or innermost of these scars is a small one, such as might result from a triple or quadruple cyst, the next is larger, while the group of Sporocysts in the mantle-margin is larger again. This plainly shows that as the mantle-margin followed the peripheral growth of the shell, the group of Sporocysts increased in size.

These compound Sporocysts are, of course, thicker than the normal thickness of the mantle, and stand out as opaque white granular eminences, obvious as soon as the shell is opened.

On the beds of Pearl-bearing Mussels in the Barrow Channel, opposite the Piel Fish-Hatchery, where every specimen of *Mytilus* is abundantly infected with the *Leucithodendrium*, and almost every specimen contains pearls, *Tapes* is not found. The Cockle, *Cardium edule* L., is common there, and acts as a host for the Sporocysts. Somewhat less than half the specimens of *Cardium* that I examined at Piel were infected. In *Cardium* the Sporocysts occurred in the mantle-margin, close to the anterior border of the anterior adductor muscle. Large groups, such as occur in *Tapes*, were not observed, but only single, triple, or quadruple cysts.

I have not yet been able to trace the infection of *Tapes* or *Cardium*. It is therefore impossible to say whether infection takes place by means of a free swimming *Miracidium* larva or not. The constant occurrence of the Sporocysts in exactly the same positions suggests that the eggs are carried into the digestive system of *Tapes* with the food-bearing current, hatch out in the alimentary canal, enter the circulatory system, and reach their destination *via* the posterior pallial artery, along the course of which they are distributed in *Tapes*. Moreover, the position in

which I found the Sporocysts in *Cardium* at Piel corresponds to the end of the anterior pallial artery.

The Cercaria in the Sporocyst first appears as a little oval cellular ball, budded off from the wall, measuring about ·05 mm. During the early stages of its development it is transparent, and its structure can be made out without difficulty; but, as it grows, its excretory organs become gradually laden and distended with opaque granules, which conceal the other parts.

The fully formed Cercariæ in the Sporocysts measure ·15 mm. to ·3 mm. They are whiter than those found in *Mytilus*, but the arrangement of the spines on the cuticle is the same. They possess a pair of pyramidal or conical light brown eye-spots (Pl. XVI. fig. 10, *e.*), each provided with a lens. There are about six tactile papillæ (*t.p.*) at the anterior end of the body. These sense-organs are no doubt serviceable to the larva, during its free living stage, after leaving *Tapes*, and before entering *Mytilus*. The digestive system (Pl. XVI. figs. 9, 10, *dig.*) is empty, and occupies less space than in the *Mytilus* stage. The form and relations of the suckers and pharynx are the same. The penis (Pl. XVI. fig. 9, *pe.*) and testes are already developed, and have the same relations as in the *Mytilus* worm. In pressure preparations of the live worm they are not easy to discern.

The majority of Cercariæ in the Sporocysts are fully developed, young transparent ones being less common. They probably remain a considerable time before vacating it. A few on their way out may often be found free in the tissues of the mantle.

Search in the mud and with the tow-net at Billiers, failed to reveal the free living stage. I have, however, found examples in water in which *Tapes* had been kept for some days.

This Trematode is not provided with a cercarian tail at any stage of its existence, and it is only capable of creeping movements. The larva in the Sporocyst is rather more active than the later stage which occurs in *Mytilus*.

If a Cercaria dies while still in the Sporocyst, its remains become calcified; but, not being enclosed in an epidermal sac, secreted by the mollusc, it does not give rise to a pearl, but merely to a concretion. Again, an exhausted Sporocyst may undergo similar calcareous degeneration with the same result.

Artificial Infection of Mytilus.

On leaving Billiers in the beginning of September 1901, I brought with me about fifty infected examples of *Tapes*. I first placed these in a tank at the Piel Fish-Hatchery, which Professor Herdman and Mr. Scott kindly placed at my disposal. In order to test experimentally the infection of *Mytilus* from *Tapes*, I put in the same tank about seventy mussels, taken from the piles of the old pier at Piel. These mussels of which I examined a number, were practically without parasites. About one in every five of the largest examples contained a Cercaria, one had two

Cercariæ, and one contained a small pearl. It is apparently difficult for infection to take place, except on the bottom, owing to the absence of swimming-organs in the parasite. Hence the absence of Cercariæ in these examples.

Eleven days after they were placed in the tank I examined two of these *Mytili*, and found that the first contained one and the second two Cercariæ. These Cercariæ were recently immigrated examples, as they were small, rather transparent, and not yet surrounded by sacs.

I then transferred the experiment to Brighton, where Mr. W. Wells, the Marine Superintendent at the Aquarium, kindly kept the molluscs in a tank in his private office.

On the 18th of November, 1901, two months after the specimens were placed in this tank, I examined six of the mussels. Of these one contained six Cercariæ, another four, two had each three parasites, one contained two, and one was still uninfected.

When the experiment was transferred to Brighton I added about two dozen mussels that had been in the Brighton Aquarium for two years. I examined six such mussels before introducing the others, and found that none of them contained live Cercariæ, though four of them had one small pearl apiece.

On 5th April, 1902, I took up a sample of 10 mussels from this tank, comprising five of the specimens originally taken from the pier at Piel, and five of those that had been transferred from another tank at Brighton.

The following table suffices to show that in both cases infection had taken place:—

(*a*) Piel Pier mussels.

No. 1.	Contained	7 Cercariæ.
No. 2.	„	3 live and 2 dead Cercariæ, one of which was partly calcified.
No. 3.	„	2 live and 2 dead Cercariæ.
No. 4.	„	4 live Cercariæ.
No. 5.	„	2 live Cercariæ.

(*b*) Specimens transferred from other tank at Brighton.

No. 6.	Contained	19 Cercariæ.
No. 7.	„	3 Cercariæ.
No. 8.	„	2 Cercariæ.
No. 9.	„	1 (dead) Cercaria.
No. 10.	Still uninfected.	

The Adult Leucithodendrium.

Although I have not had an opportunity of making a direct *feeding experiment* upon *Somateria* or *Œdemia*, there is hardly any doubt that the parasite that causes the formation of the pearl-sac, and consequently of the pearl, in *Mytilus edulis* is the larva of *Leucithodendrium somateriæ* (Levinsen), originally described from the Eider Duck (*Somateria mollissima* Linn.) in Greenland,

and rediscovered by me in the Scoter, *Œdemia nigra* L., from Bridlington Bay and the Villaine Estuary.

After finding the Sporocyst I made a careful examination of such fishes and gulls as I could secure at Billiers, but could find no parasite corresponding to the larva. However, on enquiring of the fishermen I was informed that the great enemy of the mussel in those waters is a diving duck, locally called "Cane moulière," which frequents the Villaine in winter. M. d'Hamonville, to whom I wrote on the matter, had no hesitation in saying that this bird was *Œdemia nigra.* On my visit to Billiers in December last I proved, by shooting an example and procuring four others that were taken in nets, that it was so. The name "Cane moulière" seems to be applied to another duck as well, probably the Scaup, *Fuligula marila* Linn. A few young Scoters remain on the Villaine during the summer months.

The Scoter is very common in winter at the mouth of the Barrow Channel, just opposite the pearl-bearing mussel-beds.

Before going to Billiers in December I had proved the occurrence of *L. somateriæ* (Levinsen), associated with *Levinsenia pygmæum* Lev., in a specimen of *Œdemia nigra* sent me from Bridlington by Mr. G. Williamson.

The Scoter received from Bridlington was in a rather advanced state, and I could only determine the presence of a few examples of *L. somateriæ* in the hinder part of the small intestine. But the five specimens procured on the Villaine were infested with *L. somateriæ* from the stomach to the anus and even in the cæca. I calculated that each specimen contained at least six thousand examples of the parasite. *Levinsenia pygmæum* Linn., which occurred abundantly in the Bridlington specimen, was not found at Billiers. The intestine of the Bridlington duck contained nothing but fragments of *Mytilus*-shells. The example which I shot at Billiers was feeding over mussel-beds, and the other four were caught in special nets which are placed on the beds of mussels at ebb tide, and in which the birds get entangled when they visit these beds with the flood, to feed.

These Billiers specimens had apparently been feeding exclusively on mussels, as no other food was found in them, except that one individual contained about half a dozen *Nucula* sp. and a broken *Littorina*-shell, in addition to *Mytilus.* In the crop and stomach some of the mussels were still entire, and specimens up to 40 millim. in length were found; in the stomach the shells are crushed, and pass through the intestine in small fragments at most a few millimetres in diameter.

The striking likeness, except for the matter of size, between the *Mytilus*-worm and *Leucithodendrium somateriæ*, and the occurrence of the latter in the two birds that are known to feed *par excellence* on mussels, is almost sufficient to prove their identity without the feeding experiment. I hope, however, to make this experiment if birds can be secured. So far I have been unable to purchase live examples, although I have made enquiries

in all directions. My discovery in the small intestine of a Billiers Scoter, three inches behind Meckel's diverticulum, of a single immature example of the parasite, positively identical in size and all details with the Cercaria from *Mytilus*, practically proves the point.

The adults agree with Levinsen's description and figure, except that the genital pore (Pl. XVI. fig. 11, *g.p.*) is just in front, and not in the centre, of the ventral sucker.

Levinsen's observation on this point has been treated with scepticism by later writers, and, indeed, such a position for the opening of the penis and other genital tubes would not only be a novelty in Trematode anatomy, but would probably render the sucker useless as an adhesive organ.

The adult worm varies in size from ·2 mm. to ·55 mm. It is therefore only about half the size of the larva found in *Mytilus*. It is protandrous, and specimens in which the male organs are ripe are generally larger than egg-laden females.

The diminution in size accompanying sexual maturation is of great interest, and can be accounted for in this way, I think. The resting-stage in *Mytilus* is a highly assimilative phase in the worm's existence. The bulk of the body is greatly increased by the distended gut and excretory system. A reduction in bulk would be effected by the discharge of the contents of the latter, but still more by the absorption of reserve material required to mature the gonads. In fact, the reproductive organs seem to grow at the expense of the other tissues of the body. The gut, I may mention, is empty in the adult worm.

Specimens from *Œdemia* die very quickly as a result of the *post-mortem* cooling of the body of their host. The Scoter that I shot was still warm when I dissected it, but the parasites died in a few minutes when placed on a slide, and an hour after the bird had been opened every adult worm was dead. The immature specimen above mentioned survived the death of the host by twelve hours. The temperature of the room where I worked at Billiers was very low, and possibly in a well-heated laboratory death would not ensue so quickly.

Owing to the rapid death of the worms, the material that I preserved was not suited for detailed histological work, but the relations of the various organs to one another could be determined on sections, and by this means I have been able to check my observations on pressure preparations of fresh material at Billiers.

Plate XVI. fig. 11 shows the structure of an average individual in which the maximum number of eggs has not yet been reached, and the uterus is not too complicated to mask the other structures.

The arrangement of the cuticular spines is the same as that described for the larva. The suckers and the digestive and excretory systems are also the same. The genital pore (*g.p.*) is just in front of the ventral sucker. The penis (*pe.*) is pyriform. Its extremity seems to be beset with glands. Posteriorly it goes over into the large sac-like seminal vesicle (*s.v.*). This lies dorsal to

and, as a rule, a little to the right of the sucker. At its hinder end it receives the vasa deferentia (*v.d.*). The testes (*te.*) are a little more conspicuous than in the larva. The uterus (*ut.*) opens out just in front of the penis. The arrangement of its convolutions depends upon the number of eggs contained (up to 100, or even more). It seems to begin on the left side, near the ovary (*ov.*), which is larger than the testes. It forms a series of convolutions on the left side, crosses in front of the genital opening to the right, where it forms further convolutions, passes forward as a loop to the anterior end of the body, and runs back to open out at the genital aperture. I am not convinced that this arrangement is always strictly adhered to.

The eggs in the uterus have the form depicted in my sketch and in Levinsen's figure. They measure from ·018 mm. to ·023 mm., the average dimensions being ·021 mm. × ·018 mm., but they differ considerably in different individuals. I can add nothing new to Levinsen's observations on the yolk-gland.

I sought in vain for this worm in *Bernicla brenta* Pall., *Tadorna cornuta* Gmel., *Querquedula crecca* Linn., *Colymbus arcticus* Linn., *Larus argentatus* Gmel., and *Rissa tridactyla* Linn. I have had no opportunity of examining other allied birds.

Being unable to secure live Eiders or Scoters, I tried feeding a male Pochard, *Fuligula ferina* Linn., with infected *Mytili*, but without results.

L. somateriæ will very probably be found in the other members of the genera *Somateria* and *Œdemia* when looked for.

The Conditions essential to Pearl-production.

The characters and life-history of the parasite suffice to account for the anomalous distribution of pearl-bearing mussels, and, by analogy, throw light on the cause of the differences in the number of pearls produced by the true Pearl-Oysters on various pearling and shelling grounds.

In order to be abundantly infected *Mytilus* must be on the bottom, for the tailless Cercaria or "*Cercariæum*" is dependent upon its limited creeping powers, and the chance of being transported by currents and deposited with silt, &c.

Hence mussels grown on stakes, like those on Piel pier, although right in the middle of the beds of pearl-bearing individuals, are practically uninfected.

Secondly, there must be an abundance of the first host (*Tapes* at Billiers, *Cardium* at Piel) in the immediate vicinity of the mussels, in order to ensure frequent re-infection. For I find on the coasts of the Villaine, where *Tapes* is scarce, the proportion of infected *Mytili* is small. Moreover, on the Roosebeck Scar, outside the Barrow Channel, where *Cardium* is not found, pearls do not occur frequently.

Thirdly, the beds must be near the feeding-grounds of the

Scooter (or another final host), and the set of the currents must favour the transportation of the larvæ or eggs (whichever it may be) to the beds where *Tapes* occurs.

Although it is only on certain beds that these conditions exist, infection takes place to a small extent on very many beds. I have hardly ever examined a sample of mussels from any locality without finding here and there among them an infected individual.

Duration of Life of the Larva in Mytilus, *and Rate of Growth of Pearls.*

I am at present making experiments to test the longevity of the resting larva. I have, however, three facts to record that lead me to think it is less than two years.

While the mussels on the foreshore opposite Piel Fish-Hatchery are highly infected, those on the Roosebeck Scar, outside the Barrow Channel, are not so. When I was at Piel, Mr. Scott showed me a small patch of mussels on the pearl-bearing beds, and told me that these molluscs had been brought in from the Roosebeck by a fisherman about two years previously and thrown down there. I examined a number of these mussels, and each of them contained several small pearls. Some, indeed, had as many as ten, and all were infested with the Trematode. From the presence of pearls in these specimens, it is probable that the first Cercariæ to enter them had been dead some time. The dimensions of these pearls throw some light on the time required to produce pearls of a certain size. The five largest specimens weighed together 6·9 mg. (dried on filter-paper after being preserved in spirit), and measured respectively 1·3 × 1 mm., 1·5 × 1 mm., 9 × ·85 mm., 1·2 × ·8 mm., and 2·1 × 1·15 mm. The last was obviously, from its form, a double pearl.

Again, as four out of the six specimens that I dissected after they had been about two years in the Brighton Aquarium contained each a small pearl, but no live Trematodes, it is probable that the latter were unable to survive two years in the Aquarium.

Moreover, at Piel and Billiers pearls are very seldom found in mussels less than 40 mm. long, which size is probably attained when the mussel is in its third year. I find Cercariæ, on the other hand, in specimens only 20 mm. in diameter.

The average size of the larger pearls found in old mussels at Piel is about 2 × 2 mm., but all sizes, from the dimensions of the parasite to 3·35 × 3·2 mm., were found. At Billiers they are usually smaller, as the mussels are regularly fished there and seldom reach a great age. The pearl-bearing beds at Piel are not fished, as the infected mussels are not marketable.

The sizes to which pearls grow in other molluscs differ very greatly for the several species and for the same species in different localities. Their growth is, in fact, regulated by the causes which control the thickening of the shell. Hence the white porcellaneous pearls of *Tridacna gigas* and *Hippopus*

hippopus, in which species the shell is thick and massive, are often as large as a cherry. Among the true Pearl-Oysters the large thick-shelled species, *Margaritifera maxima* Jameson and *M. margaritifera* Linn., produce the largest pearls, those yielded by the smaller *M. vulgaris* (Schumacher) on the Ceylon fisheries and elsewhere being usually small, and prized rather for their colour and lustre than for their dimensions.

And it is interesting to note that *M. vulgaris* in the Persian Gulf, where it attains larger dimensions and yields a more massive shell than in Ceylon, gives on an average larger pearls than the Gulf of Manaar pearl-oyster.

The general experience of everybody acquainted with pearl-fisheries is that the largest pearls are found in the oldest and thickest shells, which proves how intimately the growth of pearl and shell are associated. It is natural that such an association should exist, since, as is obvious from the results recorded in this paper, the mechanisms of both processes are the same.

Origin of Pearls in other Forms.

Two questions will naturally occur:—Are we warranted in assuming that the mechanism of pearl-formation is the same in other molluscs? and, Is it generally caused by Trematode larvæ?

In answer to the first question, I may say that in those cases where I have been able to examine pearls *in situ*, in *Margaritifera margaritifera* Linn., *M. vulgaris* (Schumacher), *M. maxima* Jameson, *Hippopus hippopus* L., and *Pinna nigrina* Lam., this sac is universally present. It has been noticed by von Hessling in *Margaritana margaritifera*, and by Diguet in *Margaritifera margaritifera* L., from California. But, apart from this evidence, it is safe to say that without such an epithelial sac to shed the cuticular conchyolin, the nacreous layers of the pearl could not be laid down at all.

To what extent other causes besides Trematode larvæ may be capable of inducing such sacs to develop, has yet to be ascertained. Trematodes have been unquestionably associated with pearl-formation in *Anodonta*, *Margaritana margaritifera*, *Mytilus edulis*, and *Margaritifera* (?) *mazatlanica* (see Introduction).

Besides these records, I have detected the remains of Trematodes in decalcified or sectioned pearls from the following species:—*Margaritifera margaritifera* Linn., *M. maxima* Jameson, *M. vulgaris* Schumacher, *Pinna nigrina* Lam., *P. euglypta* Hanley, *P. virgata* Menke, *Hippopus hippopus* Linn., *Tridacna gigas* Lam., and *Mytilus magellanicus*.

I examined pearls from several other molluscs, but had not sufficient material to ascertain satisfactorily. In *M. vulgaris* Schumacher, besides the Trematode, there seems to be a second organism, possibly a Gregarine, concerned in pearl-formation.

The periostracum pearls in the mantle-margin of *Modiola* are also associated with parasitic protozoa.

These data suffice to show that in many molluscs, including several of the species yielding the most valuable pearls, Trematodes are one cause, if not the exclusive cause, of pearl-formation. To what extent other parasites are capable of producing the same effects cannot be said at present. That the other causes to which pearls have from time to time been attributed play any part is a matter of the merest conjecture only, and has never, so far as I know, been demonstrated by experiment or investigation.

Possibilities of Economic Application.

The bearing of the facts recorded in this paper upon the problem of artificially producing pearls, and so meeting the difficulty presented by the increasing demand and exhausted fisheries, is obvious. It was indeed with the hope of throwing some light on this matter that I first took up the subject, about three years ago. The key to the realizing of this, so often regarded as an academic dream, lies obviously in the scientific study of the parasites which occur in the valuable forms. This was pointed out exactly fifty years ago by Filippi, but has been ignored by most subsequent writers.

The life-history of the Trematodes occurring in the genus *Margaritifera* probably agrees in the more essential points with those of other Digenea. Their adult stages may reasonably be expected to occur in the organisms that eat the pearl-oysters, notably such fishes as *Balistes*, while the first host will almost certainly be some mollusc occurring on the pearl-banks or shelling-grounds.

Having ascertained the first host, there is no reason why infection should not be performed by placing young pearl-oysters in company with it in more easily accessible waters. To attempt to establish the cultivation of pearl-oysters on new grounds without also cultivating and infecting the first host of the parasite would be futile. Needless to say, such methods of artificially promoting natural infection would be incomparably superior to any method of pearl-production by *operation* on the individual oyster, as millions of examples could be treated by the former method, while tens were being operated upon.

It is obvious from my Brighton experiment that infection can be induced in *Mytilus*, and I can see no reason to doubt that, in a couple of years, these *Mytili* will contain pearls, resulting from that artificially induced pathological condition.

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EXPLANATION OF THE PLATES.

Plate XIV.

Mytilus edulis.

Fig. 1. *Mytilus edulis* L., Billiers. Section of a small Pearl, decalcified *in situ*, showing remains of Trematode as nucleus. *ext.ep.*, external epidermis of mantle; *c.t.*, connective tissue; *bl.*, blood-corpuscles; *s.*, epithelium of pearl-sac; *con.*, conchyolin basis of pearl; *con.'*, outermost uncalcified layer of same, attached to epithelium; *cu.*, cuticle of dead Trematode; *ph.*, pharynx, and *dig.*, digestive system of same. × 90.

Fig. 2. The Trematode larva in the connective tissue of the mantle, prior to formation of sac. *f.*, fibres of connective tissue; *pr.*, proliferating cells which give rise to the epithelial sac; *cu.*, cuticle; *dig.*, digestive cæca; *ex.*, excretory organs, and *pa.*, parenchyma of the parasite. Other figures as above. × 130. The section passes between pharynx and ventral sucker. The ventral surface of the parasite is turned towards external epidermis.

Fig. 3. The cells of the proliferating epithelium which is destined to become the sac (*cf.* fig. 12). *nu.*, nuclei with chromatine reticulum; *c.t.*, connective tissue.

Fig. 4. Cells of the fully-formed sac which surrounds the Cercaria in fig. 2. *c.t.*, underlying connective-tissue cells and fibres.

PLATE XV.

Fig. 5. The sac fully developed around the larva, which is cut through ventral sucker. *s.v.*, rudimentary seminal vesicle at base of penis; *c.m.*, circular musculature; *l.m.*, longitudinal musculature; *skr.*, ventral sucker. Other letters as in previous figures. × 130.

Fig. 6. The Cercaria as it occurs in *Mytilus*. From a specimen stained *in toto*. *cu.*, cuticle; *m.*, mouth; *a.s.*, anterior sucker; *p.s.*, posterior sucker; *ph.*, pharynx; *s.gl.*, salivary glands; *œ.*, œsophagus; *dig.*, digestive cæca; *ex.*, excretory system; *ex.p.*, pore of same; *pe.*, penis; *te.*, testes; *v.d.*, vasa deferentia. × 130.

Fig. 7. The same, in longitudinal section. *pa.*, parenchyma; *pa.n.*, nucleated sub-cutaneous layer of same; *int.ep.*, intestinal epithelium, in surface view; *g.p.*, genital pore; *c.m.*, circular musculature; *l.m.*, longitudinal ditto. *m.f.*, muscle-fibre in parenchyma; *n.c.*, supra-œsophageal nerve-commissure Other letters as in fig. 6. × 130.

PLATE XVI.

Fig. 8. Dead Cercaria in *Mytilus*, with three centres of calcification. × 130.

Fig. 9. Section of the muscular mantle-margin of *Tapes*, showing the Sporocysts with contained Cercariæ. *m.*, musculature of *Tapes*; *sp.*, sporocyst; *cer.*, Cercaria; *ex.*, excretory tubes; *dig.*, digestive cæca; *pe.*, penis; *s.*, ventral sucker of same.

Fig. 10. Pressure preparation of the Cercaria from Sporocyst in *Tapes*. The specimen was examined alive, so sexual organs are not visible. *e.*, eyes; *t.p.*, tactile papillæ; *dig.*, digestive cæca; *ex.*, excretory system. × 700.

Fig. 11. The adult worm from *Œdemia nigra* L., River Villaine. *s.v.*, seminal vesicle; *ov.*, ovary; *ut.*, uterus; *g.p.*, genital pore. Other letters as in fig. 6. Stained *in toto*.

PLATE XVII.

Fig. 12. *Mytilus edulis* L., Piel, Lancashire. Photo of a thin slice or "Schliff" through centre of pearl, showing calcified Trematode as nucleus. × 25.

Fig. 13. Ditto. Pearl formed in sac vacated by Trematode. A few granules of residual matter have calcified to form nucleus. × 25.

Fig. 14. Ditto, showing several centres of calcification in the Trematode. × 25.

Fig. 15. Ditto, double pearl, one of constituents being formed around Trematode, the other as in fig. 13. × 25.

Fig. 16. Pearl from *Margaritifera margaritifera* Linn., New Guinea, showing imperfectly calcified Trematode, with radially arranged prisms. × 25.

2. List of the Parrots represented in the Society's Collection in January 1902, with Remarks on some of the Rarer Species. By P. L. SCLATER, D.Sc., F.R.S., Secretary to the Society.

[Received February 20, 1902.]

(Plates XVIII. & XIX.[1])

The birds in the Society's Parrot-house having been lately re-arranged and the duplicates and "deposited" specimens having been moved to another place, I have thought it worth while to prepare a list of the species of Psittacidæ now represented in the Collection, which may be useful in future years, and to add to it a few notes on some of the rarer forms.

It may be observed that the 147 specimens of Parrots now

[1] For explanation of the Plates, see p. 171.

living in the Parrot-house are referable to the following 107 species[1], which are arranged and named according to the order followed in the last edition of the 'List of Vertebrated Animals, (1896).

List of living Parrots, 1902.

Fam. Nestoridæ.

*1. *Nestor notabilis* Gould.

Fam. Loriidæ.

2. *Eos rubra* (Gm.).
3. —— *riciniata* (Bechst.).
4. —— *wallacii* (Finsch).
5. *Lorius domicella* (Linn.).
6. *Trichoglossus hæmatodes* (Linn.).
7. —— *forsteni* (Temm.).
8. —— *novæ-hollandiæ* (Gm.).

*9. —— *rubritorques*, Vig. & Horsf.

10. —— *ornatus* (Linn.).
11. *Psitteuteles euteles* (Temm.).
12. *Glossopsittacus concinnus* (Shaw).

Fam. Cacatuidæ.

Subfam. Cacatuinæ.

13. *Calyptorhynchus naso* Gould.
14. *Callocephalon galeatum* (Lath.).
15. *Cacatua galerita* (Lath.).
16. —— *triton* Temm.
17. —— *sulphurea* (Gm.).
18. —— *leadbeateri* (Vig.).
19. —— *moluccensis* (Gm.).

*20. —— *gymnopis* Sclater.

21. —— *sanguinea* Gould.
22. —— *ducorpsi* Hombr. et Jacq.
23. —— *hæmaturopygia* (P. L. S. Müll.).
24. —— *roseicapilla* Vieill.

Subfam. Calopsittacinæ.

25. *Calopsittacus novæ-hollandiæ* (Gm.).

Fam. Psittacidæ.

Subfam. Conurinæ

26. *Anodorhynchus hyacinthinus* (Lath.).
27. —— *glaucus* (Vieill.).
28. *Ara ararauna* (Linn.).

[1] In March 1879 there were 170 Parrots in the Society's Collection, referable to 98 species (see P. Z. S. 1879, p. 299).

29. *Ara macao* (Linn.).
30. —— *chloroptera* Gray.
31. —— *militaris* (Linn.).
32. —— *severa* (Linn.).
33. —— *maracana* (Vieill.).
34. *Conurus acuticaudatus* (Vieill.).
35. —— *auricapillus* (Licht.).
36. —— *nanday* (Desm.).
37. —— *rubrolarvatus* Mass. et Souancé.
38. —— *holochlorus* Sclater.
39. —— *ocularis* Sclater & Salv.
40. —— *cactorum* (Max.).
41. —— *æruginosus* (Linn.).
42. *Conuropsis carolinensis* (Linn.).
43. *Cyanolyseus patagonus* (Vieill.).
44. *Pyrrhura leucotis* (Licht.).
45. *Myopsittacus monachus* (Bodd.).
46. *Psittacula passerina* (Linn.).
47. *Brotogerys virescens* (Gm.).
48. —— *pyrrhopterus* (Lath.).
49. —— *tui* (Gm.).

Subfam. PIONINÆ.

*50. *Chrysotis guildingi* (Vigors).
*51. —— *augusta* (Vigors).
52. —— *amazonica* (Linn.).
53. —— *æstiva* (Linn.).
54. —— *ochrocephala* (Gm.).
55. —— *auripalliata* (Less.).
56. —— *levaillanti* Gray.
57. —— *viridigena* Cass.
58. —— *salvini* Salvad.
59. —— *autumnalis* (Linn.).
60. —— *inornata* Salvad.
61. —— *festiva* (Linn.).
*62. —— *bouqueti* (Bechst.).
63. —— *albifrons* (Sparrm.).
64. —— *ventralis* (Müll.).
65. —— *leucocephala* (Linn.).
66. —— *agilis* (Linn.).
67. *Pionus maximiliani* (Kuhl).
68. —— *chalcopterus* (Fraser).
69. *Caica melanocephala* (Linn.).
70. *Pœocephalus gulielmi* (Jard.).

Subfam. PSITTACINÆ

*71. *Psittacus erithacus* Linn.
72. *Coracopsis vasa* (Linn.).
73. —— *nigra* (Linn.).

Subfam. PALÆORNITHINÆ.

74. *Electus pectoralis* (Müll.).
*75. —— *westermanni* Bp.
76. —— *cardinalis* (Bodd.).
77. *Tanygnathus luzonensis* (Linn.).
78. *Palæornis torquata* (Bodd.).
79. —— *docilis* (Vieill.).
80. —— *fasciata* (Müll.).
81. —— *eupatria* (Linn.).
82. —— *magnirostris* Ball.
83. —— *derbianus* Fraser.
84. —— *schisticeps* Hodgs.
*85. —— *finschi* Hume.
86. *Polytelis barrabandi* (Swains.).
87. —— *melanura* (Vig.).
88. *Ptistes erythropterus* (Gm.).
89. *Aprosmictus cyanopygius* (Vieill.).
90. *Pyrrhulopsis splendens* (Peale).
91. *Loriculus galgulus* (Linn.).
92. —— *vernalis* (Sparrm.).

Subfam. PLATYCERCINÆ.

93. *Platycercus elegans* (Gm.).
94. —— *flaveolus* (Gould).
*95. —— *mastersianus* Ramsay.
96. —— *pallidiceps* Vig.
97. —— *eximius* (Shaw).
98. —— *barnardi* (Lath.).
99. —— *browni* (Temm.).
100. —— *semitorquatus* (Quoy et Gaim.).
101. —— *zonarius* (Shaw).
102. *Psephotus multicolor* (Brown).
103. —— *hæmatonotus* Gould.
*104. —— *chrysopterygius* Gould.
105. *Cyanorhamphus unicolor* (Vig.).
106. —— *novæ-zealandiæ* (Gm.).
107. *Melopsittacus undulatus* (Shaw).

1. NESTOR NOTABILIS.

A pair of these birds were presented to us by the Hon. Walter Rothschild, F.Z.S., on Feb. 16th, 1899. They are fed upon ordinary food, and have no meat given to them, as was, at one time, thought to be necessary. They are in excellent health and condition.

9. TRICHOGLOSSUS RUBRITORQUES.

Of this beautiful Australian species the four examples, deposited by the Hon. W. Rothschild, F.Z.S., July 27th, 1900, are the first

and only specimens ever received by the Society. (See P. Z. S. 1900, p. 772.)

20. Cacatua gymnopis.

This specimen is the oldest bird in the Parrot house, having been in the Society's possession for 33 years. It was purchased June 2nd, 1868.

50. Chrysotis guildingi.
51. „ augusta.
62. „ bouqueti.

We have always a good series of specimens of the Neotropical genus *Chrysotis* in the Collection. We are now so fortunate as to possess examples of these three rare Antillean species, and only a short time ago had also an example of *C. versicolor* of Dominica. (See P. Z. S. 1890, p. 772.)

71. Psittacus erithacus.

One of our specimens of this bird (received Dec. 24th, 1897) has a pure white tail.

75. Eclectus westermanni. (Plate XVIII.)

In 1899 and 1900 we received under our care a series of ten specimens of both sexes of this bird, deposited by Mr. Rothschild. Whatever doubts may have been formerly expressed, it is now, I think, quite certain that this is a valid species, although we do not yet know its exact locality. Mr. Rothschild having already published his notes on this remarkable species (Bull. B. O. C. x. p. ii, Oct. 1899), I need not repeat them here further than to say that the male is at once recognizable by its entirely green breast, and that the female is most like the corresponding sex of *E. pectoralis* but has a dull purple (not blue) lower breast.

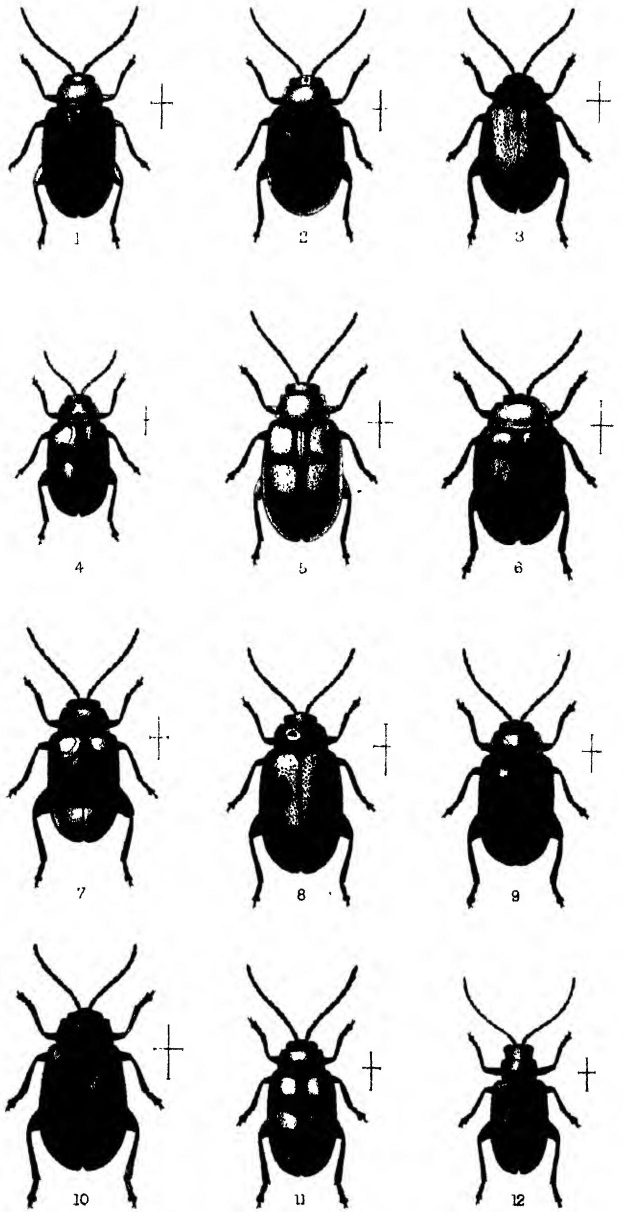
85. Palæornis finschi.

This is a rare species from Burmah, of which we received our first specimen in Nov. 1901 from Mr. E. W. Harper, F.Z.S., to whom we are indebted for examples of so many rare Indian species. (See Cat. B. xx. p. 458, pl. xii.)

95. Platycercus mastersianus. (Plate XIX.)

Platycercus mastersianus, Ramsay, Pr. Linn. Soc. N.S.W. ii. p. 27 (1877); Salvad. Cat. B. xx. p. 543.

We are so fortunate as to have a single example of this rare bird in the Collection, deposited by Mr. Rothschild on the 29th Oct., 1897, and I have great pleasure in exhibiting a coloured drawing of it prepared by Mr. Smit (Plate XIX.). It is clearly a member of the group of *P. elegans*, but differs from all others in having the central parts of the tail-feathers whitish. Count Salvadori was unacquainted with it, and merely copied the original description in a footnote.



W Purkiss del et lith

West, Newman imp.

NEW SPECIES OF HALTICIDÆ

104. Psephotus chrysopterygius.

Of this species, perhaps the most beautiful of all Australian Parrakeets, we received a pair in immature plumage in March 1897. They are now in full plumage and in excellent condition.

EXPLANATION OF THE PLATES.

Plate XVIII.

Eclectus westermanni, ♂ and ♀ adult, p. 170.

Plate XIX.

Platycercus mastersianus, p. 170.

(Taken from specimen deposited on Oct. 29, 1897.)

3. Descriptions of New Species of Coleoptera of the Family *Halticidæ* from South and Central America. By Martin Jacoby, F.E.S.

[Received February 15, 1902.]

(Plate XX.[1])

The constant application for the determination of so many specimens of Halticidæ which I have received from different sources has induced me to describe most of those which are contained in my collection, for a long time unnamed, as a further contribution to the extremely numerous described forms from South and Central America. The subject can scarcely be dealt with at present in anything but a very incomplete manner, but every little helps and will one day assist in grouping together the enormous material known, when the time and opportunity has arrived for a proper monograph of this immense family, such as has been attempted with the species known from Central America, in the great work on that country by Godman and Salvin.

The present paper deals with that division of the Halticidæ in which a more or less distinct thoracic sulcus is present in connection with simple, not inflated, posterior claws.

Diphaulaca costatipennis, sp. n.

Dark metallic blue, the basal joints of the antennæ fulvous; thorax obscure cupreous, impunctate; elytra closely and nearly irregularly punctured, the sides with two or three longitudinal costæ.

Length 4 millim.

Head impunctate, the frontal elevations elongate, divided by a deep groove, the carina acute; antennæ long and slender, black, the lower three joints fulvous below, stained with metallic blue above; thorax subquadrate, the sides straight at the base, rounded

[1] For explanation of the Plate, see p. 204.

before the middle, the angles acute, the basal sulcus very deep, straight, bounded at the sides by a perpendicular groove, the surface entirely impunctate; elytra much wider at the base than the thorax, the basal portion slightly raised, the disc very closely and distinctly punctured, the punctures arranged in indistinct rows, much finer towards the apex, a well-marked costa extends from the shoulders nearly to the apex and is preceded by a shorter one which does not extend upwards to the base, the interstices between these costæ more irregularly and more strongly punctured than the rest of the surface, elytral epipleuræ broad, with a row of punctures; below and the legs metallic blue, impunctate, the last segment of the abdomen with a longitudinal groove which widens at the apex, the sides of the segment slightly raised.

Hab. Venezuela.

The single specimen before me is probably a male, although the anterior tarsi are not particularly dilated. The species differs from its allies in the sculpture and costæ of the elytra, in connection with its coloration.

DIPHAULACA FLAVIPES, sp. n.

Below piceous, above greenish-æneous, the basal joints of the antennæ and the legs entirely flavous; thorax impunctate, with deep transverse sulcus; elytra with the basal portion convex, scarcely perceptibly punctured except near the base.

Length 4 millim.

Head impunctate, æneous, the frontal elevations small, ovate; antennæ slender, blackish, the lower four joints flavous, the third and fourth of equal length; thorax one-half broader than long, the sides straight at the base, rounded anteriorly, the angles acute, the disc deeply transversely sulcate, the sulcus sinuate, bounded at the sides by a perpendicular groove, entirely impunctate; elytra widened towards the middle, the apex of each rounded, the base distinctly swollen, the shoulders prominent, the surface extremely finely punctured at the base, the punctures scarcely arranged in rows and very closely placed, nearly obsolete below the middle, the epipleuræ very broad, concave; below obscure piceous, the legs entirely flavous.

Hab. Colombia (*Pehlke*). Museum Stettin and my collection.

This small species may be at once known by the entirely æneous upper surface and the flavous legs. The specimen before me seems to be a female.

DIPHAULACA PALLIPES, sp. n.

Below black, above greenish-æneous, the basal joints of the antennæ and the legs (the posterior femora excepted) flavous; thorax impunctate, the basal sulcus deep; elytra finely punctate-striate, the punctures indistinct near the apex.

Length 2 millim.

Head impunctate, the frontal tubercles narrowly oblique, the carina acute, the lower portion of the face and the labrum black,

the vertex greenish æneous; the antennæ rather long and slender, flavous, the terminal joints fuscous, the third and fourth joints equal, scarcely longer but much thinner than the second one; thorax twice as broad as long, the sides straight, the anterior angles oblique, forming a distinct tooth before the middle, posterior margin rather broadly produced at the middle, the basal sulcus deep and sinuate, bounded at the sides by deep perpendicular grooves, the surface rather convex, impunctate, greenish-æneous; elytra with the base slightly raised, distinctly punctured in closely approached rows which become obsolete near the apex; legs flavous, the posterior femora blackish.

Hab. St. Catharina, Brazil.

Of only half the size of *D. flavipes*, the basal margin of the thorax not straight as in that species, but slightly produced at the middle, the punctuation of the elytra more distinctly arranged in rows, and the posterior femora black, not flavous.

DIPHAULACA FRUHSTORFERI, sp. n.

Greenish-æneous, basal joints of the antennæ and the base of the femora (more or less) testaceous; head deeply foveolate; thorax obsoletely punctured, metallic green or æneous, the basal sulcation deep; elytra with the base raised, rather strongly and closely punctate-striate, metallic green or brassy.

Length $3\frac{1}{2}$ millim.

Head impunctate, deeply foveolate between the eyes, the latter large and prominent, frontal elevations obsolete, carina acute; antennæ rather long and slender, piceous, the lower four joints and the apical one testaceous, third and fourth joints equal, terminal joints equally long, not thickened; thorax transversely subquadrate, the sides straight, the anterior angles slightly thickened and oblique, the basal sulcus deep, bounded at the sides by equally deep perpendicular grooves, the surface convex, nearly impunctate, brassy green; elytra with the base distinctly raised, the basal margin preceded by a deep groove which extends in front of the shoulders, the surface strongly and closely punctate-striate anteriorly, the punctures very much finer towards the apex, below dark æneous; legs robust, piceous, the femora more or less testaceous at the base, posterior tibiæ slightly curved and dilated at the apex.

Hab. St. Catharina, Brazil (*Fruhstorfer*).

Principally distinguished from other species of the genus by the deep frontal fovea, the strong and close punctuation of the elytra, and the colour of the legs.

DIPHAULACA HAROLDI, sp. n.

Below blackish, above greenish-æneous, the basal three joints of the antennæ flavous; thorax transverse, finely punctured; elytra with the basal portion convex, regularly punctate-striate, the striæ remotely placed.

Length $2\frac{1}{2}$ millim.

Head impunctate, the frontal elevations small, the carina acutely raised; antennæ extending to the middle of the elytra, black, the lower three joints flavous, second and third joints equal, fourth scarcely longer, the terminal joints gradually thickened; thorax quite one-half broader than long, the sides nearly straight, the anterior angles obliquely thickened, the basal sulcus deep, not extending beyond the perpendicular grooves at the sides, the disc convex, remotely and finely punctured, elytra with the base distinctly raised, punctured in regular and not closely placed rows, distinct to the apex, the last row near the lateral margins more strongly punctured, the last interstice slightly convex; below and the legs nearly black; prosternum broadly elongate, distinctly punctured.

Hab. Colombia.

One of the smallest species of the genus, and distinguished from its Colombian congeners by the finely but distinctly punctured thorax.

Genus Lactica.

a. *Elytra blue or green.*

Lactica boliviana, sp. n.

Ferruginous, the antennæ (the basal three joints excepted), the apex of the tibiæ, the tarsi, and the abdomen black; elytra violaceous blue, strongly punctured; thorax impunctate, the basal sulcus deep; posterior legs entirely black.

Length 5 millim.

Head impunctate, obliquely grooved above the antennæ, carina short, labrum piceous; eyes very slightly emarginate; antennæ scarcely extending to the middle of the elytra, black, the lower three joints fulvous, third and fourth joints equal, the second one scarcely shorter; thorax twice as broad as long, rather convex, not narrowed anteriorly, the sides straight, the anterior angles oblique, the basal sulcus deep and straight, placed close to the base, the surface impunctate; scutellum fulvous; elytra convex, violaceous blue, distinctly punctured in closely approached irregular rows, distinct to the apex; legs and the breast ferruginous, the apex of the four front tibiæ, the tarsi, the posterior legs entirely, and the abdomen black.

Hab. Bolivia.

Closely allied in coloration to *L. elegantula* Har., but much larger, without distinct frontal elevations, the third and fourth joints of the antennæ equal; the head impunctate, and the elytral punctuation distinct to the apex. *L. abdominalis* Jac. is much smaller and has fulvous posterior legs.

Lactica lobata, sp. n.

Oblong-ovate, ferruginous, apical joints of the antennæ black; thorax impunctate, the basal sulcus rather deep, basal margin

produced at middle; elytra metallic blue or greenish, finely punctured in rows; abdomen black.

Length $4\frac{1}{2}$ millim.

Head impunctate, the frontal tubercles entirely obsolete, the carina short, pyriform; eyes large, nearly entire; antennæ extending to about the middle of the elytra, black, the lower four joints ferruginous, the third and fourth joints equal, but little longer than the second joint; thorax twice as broad as long, the sides very feebly rounded, narrowly marginate, the anterior angles oblique, not produced, the basal margin rounded and produced at the middle, the basal sulcus straight and moderately deep, the perpendicular grooves very deep, the surface impunctate, ferruginous; scutellum fulvous; elytra convex, subcylindrical, finely punctured in closely approached rather regular rows, distinct to the apex; breast and legs ferruginous; abdomen black.

Hab. Bolivia.

In this species the basal margin of the thorax has a distinct round lobe at the middle, differing in this respect from most of the other species of the genus: this character alone would scarcely justify the creation of another genus, but it will assist in the recognition of the species, in connection with the system of coloration and the black abdomen.

LACTICA FUNEREA, sp. n.

Entirely dark violaceous, the last five joints of the antennæ fulvous; thorax transverse, impunctate, the basal sulcus deep; elytra purplish-violaceous, extremely finely punctured.

Length 6 millim.

Elongate, convex, the head impunctate, frontal elevations entirely obsolete; eyes not very large; clypeus thickened, wedge-shaped, carina narrow; antennæ nearly reaching the end of the elytra, black, the last five joints fulvous, the second half the length of the third joint; thorax strongly transverse, more than twice as broad as long, the sides perfectly straight, narrowly margined, the anterior angles oblique, the disc entirely impunctate, blackish-violaceous, the basal sulcus and the perpendicular grooves very deep; elytra metallic purplish-violaceous, very finely punctured when seen under a strong lens; below and the legs nearly black.

Hab. Yurimaguas, Peru.

Of this very distinct species, two specimens are in my collection.

LACTICA COSTATIPENNIS, sp. n. (Plate XX. fig. 1.)

Flavous, the antennæ (the basal joints excepted) and the tibiæ and tarsi black; thorax impunctate, the basal sulcus deep; elytra bright green, finely rugosely punctate, the sides of each with an acute costa.

Length 6 millim.

Head flat and impunctate, the frontal elevations obsolete

clypeus slightly raised, anterior edge of the labrum black; eyes oblong, slightly sinuate; antennæ extending to the middle of the elytra, black, the lower three joints more or less flavous below, the third joint smaller than the fourth, all the following joints elongate; thorax twice as broad as long, the sides rounded, the anterior angles simple, not oblique, basal sulcus deep, slightly sinuate, the surface flavous, impunctate; scutellum triangular, fuscous; elytra extremely closely and rather finely rugosely punctured, not very shining, with an acute ridge from the shoulders to the apex, accompanied by another shorter ridge below the middle; below flavous, the lower portion of the tibiæ and the tarsi fuscous.

Hab. Llano Grande, Guatemala.

I have seen only a single example of this very distinct species, which is in my collection.

LACTICA BILINEATA, sp. n.

Flavous, the antennæ black; thorax transverse, impunctate, with deep basal sulcus; elytra metallic blue, microscopically punctured, each with a narrow flavous streak from the base to below the middle.

Length 4 millim.

Head with a few deep punctures near the eyes, flavous, the frontal elevations strongly raised; clypeus flattened, subquadrate, but slightly raised between the eyes; labrum piceous; eyes very large, distinctly emarginate; antennæ piceous, the second joint half the length of the third, the other joints wanting; thorax more than twice as broad as long, very short, the sides straight, the anterior angles oblique, the basal sulcus very deep, placed close to the base and nearly straight, the disc impunctate; scutellum broad, black; elytra elongate and parallel, metallic dark blue, with a few very fine punctures at the base, from the middle of the latter proceeds a narrow flavous stripe which extends to below the middle and is much constricted medially, its direction is towards the suture; below stained with piceous, the legs pale flavous.

Hab. Peru.

Easily recognizable on account of its coloration, which is probably variable in regard to the elytral flavous stripes. I possess only a single specimen of this very distinct species.

b. *Elytra with spots or striped.*

LACTICA SEMINIGRA, sp. n. (Plate XX. fig. 2.)

Head and thorax flavous, the antennæ, the breast, and legs black; head and thorax impunctate; elytra flavous, with a subquadrate large black patch from the base to below the middle.

Length 6 millim.

Head impunctate, shining, flavous, with a small fovea between the eyes, clypeus strongly raised in shape of a triangular ridge,

antennæ extending beyond the middle of the elytra, black, the basal joint flavous below, the lower three joints shining, the rest pubescent, third joint much shorter than the fourth; thorax twice as broad as long, the sides straight, the anterior angles oblique, the basal margin rounded and rather prominent at the middle, the basal sulcus shallow, bounded laterally by deep perpendicular grooves, the surface impunctate; scutellum testaceous; elytra not perceptibly punctured, the anterior portion occupied by a large black subquadrate patch which does not extend to the lateral margins, the rest of the surface pale flavous, very shining; the breast and legs black, the abdomen flavous.

Hab. Cachabé, Ecuador (*Rosenberg*).

I know only a single specimen of this very distinct species, which is in my collection.

LACTICA BICOLORATA, sp. n. (Plate XX. fig. 3.)

Broadly ovate and convex, testaceous, the antennæ, thorax, legs, and the sides of the breast black; elytra minutely punctured, testaceous, the apical portion in shape of a transverse oblique band, black.

Length 6 millim.

Head impunctate, the frontal tubercles flattened, testaceous; antennæ extending to the middle of the elytra, black, the first joint testaceous below, third and following joints elongate, rather robust; thorax nearly three times broader than long, the sides straight, the anterior angles oblique, the basal sulcus shallow, the perpendicular grooves at the sides deep, the surface impunctate, black; scutellum black; elytra widened posteriorly, minutely punctured, testaceous, a transverse band, its inner margin concave and widened at the suture, occupies about the apical fourth portion of the elytra; below testaceous, the sides of the breast and the legs black.

Hab. Peru.

Allied to *L. batesi* Baly, but with differently coloured antennæ and legs, and the black elytral portion narrower, the thoracic sulcus also more shallow.

LACTICA LIMBATIPENNIS, sp. n.

Ovate, pale testaceous; antennæ very long; thorax impunctate, the basal sulcus very shallow; elytra extremely finely and closely punctured, black, the lateral and apical margins narrowly pale flavous.

Var. Elytra testaceous, the basal portion more or less black only.

Length 2 millim.

Head impunctate, flavous; the eyes entire, frontal elevations distinctly raised, clypeus flat; antennæ quite extending to the apex of the elytra, very slender, entirely flavous, the second and following two joints gradually elongated; thorax scarcely twice as broad as long, the sides feebly rounded, the anterior angles not

oblique, the basal sulcus very obsolete as well as the perpendicular grooves, the disc impunctate, flavous; scutellum flavous; elytra extremely closely and minutely punctured, convex, black, surrounded by a pale flavous margin which widens rather at the apex; below and the legs pale testaceous, the middle of the breast sometimes stained with black.

Hab. Peru.

There are five specimens of this small species in my collection. Of these two represent the variety which has the base of the elytra black only and the rest of the disc faintly stained with fuscous, so that the pale lateral margins are still plainly distinct.

c. *Elytra entirely pale-coloured.*

LACTICA PARAGUAYENSIS, sp. n.

Flavous; antennæ robust, black, the basal three joints flavous; thorax strongly transverse, the basal sulcus rather shallow; elytra parallel, flavous, impunctate, the apex of the femora piceous, the tibiæ and tarsi black.

Length 5 millim.

Of elongate, not very convex shape; the head impunctate with the exception of a single deep puncture near the eyes, the latter not large, frontal elevations only indicated, the carina very broad and convex, clypeus likewise strongly raised; labrum flavous, apex of the mandibles and the palpi piceous; antennæ comparatively robust, black, the lower three joints flavous, stained with piceous above, the second and third joints small, of equal length, the following joints rather dilated; thorax more than twice as broad as long, the sides straight, obliquely narrowed anteriorly, the anterior angles obliquely produced, the basal sulcus shallow, placed close to the base, the lateral perpendicular grooves very deep, the surface entirely impunctate; scutellum rather broad, triangular; elytra impunctate.

Hab. Paraguay.

This *Lactica*, of which a single specimen is contained in my collection, may be distinguished by the rather robust antennæ, the rather small-sized and widely separated eyes, and especially by the very transversely shaped thorax and its produced and oblique anterior angles. It differs in this respect from any of the many similarly coloured species of the genus.

LACTICA APICIPES, sp. n.

Elongate, moderately convex, testaceous, the antennæ (the basal joint excepted), the apex of the tibiæ, and the tarsi black; thorax impunctate, transverse sulcus shallow, perpendicular grooves deep; elytra extremely minutely punctured.

Length 4–5 millim.

Of elongate, parallel, and moderately convex shape, the head impunctate, the frontal elevations obsolete, carina broad; eyes very

large, slightly emarginate within; antennæ extending below the middle of the elytra, black, the basal joint flavous, second joint less than half the length of the third, the latter slightly shorter than the fourth joint, terminal joints shorter than the intermediate ones; thorax about one-half broader than long, rather flattened, the sides very feebly rounded and very slightly narrowed anteriorly, the anterior angles obsoletely oblique and slightly thickened, the basal sulcus moderately deep in the male, more shallow in the female; elytra microscopically punctured; below and the legs testaceous, the apex of the tibiæ and the tarsi black.

Hab. Balthazar (windward side), Grenada, W. Indies (*H. H. Smith*).

I identified this species formerly with *L. tibialis* Oliv., but the three specimens before me, after a closer examination, must represent another species: they are of a very pale testaceous colour, without punctuation of the head and thorax, and all have only the apex of the tibiæ and the tarsi black, differing in that respect from any of its allies. The specimen that I look upon as the male is much smaller, the thoracic sulcus is deeper, and the anterior tarsi have their first joint dilated.

LACTICA WEISEI, sp. n.

Ovate, pale fulvous, the antennæ (the basal joint excepted) black, long and slender; thorax transverse, with deep basal sulcus, impunctate; elytra not perceptibly punctured; below and the legs fulvous.

Length 4 millim.

Head with a transverse groove at the vertex and some deep punctures near the eyes, the latter large, deeply emarginate, the intermediate space with a very deep fovea, frontal elevations absent; clypeus broad, ill-defined, and scarcely raised; antennæ nearly extending to the apex of the elytra, black, the lower three joints fulvous, the third joint slightly longer than the second, the following joints very elongate; thorax twice as broad as long, the sides feebly rounded, with a distict narrow margin, anterior angles obliquely thickened, the basal sulcus very deep and straight, the surface entirely impunctate; elytra ovate, impunctate; underside and legs fulvous; the last abdominal segment triangularly emarginate. (♀?)

Hab. Pernambuco.

The structure of the head and the unicolorous legs well distinguish this species.

LACTICA STRIGATIPES, sp. n.

Flavous, the antennæ (the basal joint excepted), the apex of the femora above, and the tibiæ and tarsi black; thoracic sulcus deep; thorax and elytra impunctate.

Length 3½ millim.

Of very convex shape, subcylindrical; the head impunctate, with a rather deep impression above the eyes, the latter elongate,

slightly emarginate, frontal tubercles small and obsolete, labrum piceous; antennæ extending to the apex of the elytra, black, the basal two joints flavous, stained with piceous above, third and fourth joints equal; thorax transverse, slightly narrowed anteriorly, the sides nearly straight, the anterior angles strongly oblique, the surface impunctate, the basal sulcus deep and sinuate; elytra slightly widened towards the middle, impunctate; below and the femora flavous, the latter with a short black streak above near the apex, the tibiæ and tarsi entirely black.

Hab. Pichindé, Colombia.

I cannot identify this species, of which three specimens are before me, with any other described *Lactica* on account of the long antennæ, the entirely impunctate upper surface, and the markings of the femora, which are the same in all the specimens. There have been a great many species described of almost similar coloration, of which *L. citrina* Harold is perhaps the most closely allied, but this species has a fine but distinct punctuation and is without the femoral stripe.

LACTICA SEMIFULVA, sp. n.

Rufous or flavous, the head and thorax black, shining and impunctate; elytra not perceptibly punctured; antennæ and legs flavous.

Length 4 millim.

Head impunctate, black, shining, the frontal tubercles obsolete, the carina comparatively very broad and convex, clypeus deflexed, labrum pale piceous; antennæ long and slender, entirely fulvous, the third joint slightly shorter than the fourth, this and the following joints nearly equal; thorax transverse, about one-half broader than long, the sides with a narrow margin, straight, the anterior angles oblique, posterior acute; the disc impunctate, black, shining, the basal sulcus deep, bounded at the sides by another deep longitudinal groove; scutellum fulvous; elytra with a shallow depression below the base, of a bright rufous or pale fulvous colour, entirely impunctate, shining; the underside and the legs flavous.

Hab. Espirito Santo, Brazil.

Of this very distinct species I possess three specimens, two of which have the elytra of much paler colour than the other. *L. dichroa* Har. seems to be a nearly allied species, but has the antennæ, the underside, and the legs black; this and v. Harold's species are the only members of the genus with which I am acquainted having a black head and thorax and fulvous elytra.

LACTICA FLAVILABRIS, sp. n.

Flavous, the head black; thorax short, strongly transverse, impunctate; elytra elongate, parallel and strongly convex, rufous, impunctate.

Length 6 millim.

Head black and shining, the eyes extremely large, the inter-

mediate space very narrow, the frontal tubercles small, the carina acute, the clypeus triangularly raised; labrum flavous, as well as the palpi; antennæ extending to the middle of the elytra, flavous, the last two joints wanting, the second joint half the length of the third; thorax twice as broad as long, narrowed to a slight degree anteriorly, the sides straight, the anterior angles oblique, the disc impunctate, flavous; the basal sulcus very deep, sinuate, and placed rather closely near the basal margin; scutellum rather broad; elytra convex, elongate and widened towards the middle, not perceptibly punctured; below and the legs flavous.

Hab. Espirito Santo, Brazil.

Evidently allied to *L. capitata* Illig., but rather smaller, more convex, the antennæ and the labrum entirely flavous, the first-named shorter, the eyes still larger, and the elytra reddish-fulvous, not testaceous.

LACTICA RUFO-BASALIS, sp. n.

Elongate, parallel, flavous; the antennæ (the basal joint excepted) black; head and thorax reddish, impunctate, the basal sulcus very deep; elytra impunctate, flavous, the base reddish fulvous; below and the legs flavous.

Length 7 millim.

Head impunctate, reddish fulvous, very shining, the frontal tubercles rather obsolete, carina acute and narrow; eyes large, coarsely granulate, the intermediate space not broader than their diameter; antennæ extending beyond the middle of the elytra, black, the basal joint flavous, the third joint twice as long as the second, but shorter than the fourth joint; thorax about one-half broader than long, slightly narrowed anteriorly, the sides straight, with a rather broad, reflexed margin, the anterior angles oblique, the disc extremely shining, impunctate, the basal sulcus very deep, placed at some distance from the base, the lateral perpendicular grooves still deeper; elytra subcylindrical, scarcely widened at the middle, not distinctly punctured but crowded with numerous piceous specks, the basal margin reddish, the rest of the surface flavous, the metatarsus of the posterior legs as long as the following joints together.

Hab. Tejuca, Brazil.

This is a large-sized species, of which a single example is in my collection. It is distinguished by the coloration of the head, thorax, and elytra, the flavous legs, and very deep thoracic sulcus.

LACTICA FEMORATA, sp. n.

Flavous, elytra rufous, the posterior femora piceous; head and thorax impunctate, the basal sulcus very deep and sinuate, elytra impunctate.

Length 2½ millim.

Head impunctate, eyes large, entire, frontal elevations obsolete, carina short, acute; antennæ entirely fulvous, extending beyond

the middle of the elytra, the second and third joints short, nearly equal; thorax twice as broad as long, slightly narrowed anteriorly, the sides nearly straight, the anterior angles oblique, the posterior margin sinuate, the basal sulcus very deep and sinuate, the surface impunctate, flavous; scutellum broad; elytra ovate and convex, with a distinct depression within the shoulders, rufous, shining and impunctate; underside and legs paler, the posterior femora black except at the extreme base, metatarsus of the posterior legs elongate.

Hab. Espirito Santo, Brazil.

A small species, distinguished by the colour of the antennæ, of the elytra, and that of the posterior femora.

LACTICA CLARKI, sp. n.

Elongate, subdepressed, flavous; labrum and the antennæ (the basal two joints excepted), the knees, tibiæ, and tarsi black; thorax not narrowed in front, impunctate, with deep basal sulcus; elytra narrow and parallel, nearly impunctate.

Length 3 millim.

Head impunctate, the frontal tubercles broad, feebly raised, carina likewise flattened and broad; labrum and palpi black; eyes large, entire; antennæ comparatively short and robust, black, the basal two joints flavous, third joint scarcely shorter than the fourth; thorax transverse, scarcely twice as broad as long, the sides perfectly straight, not narrowed in front, the anterior angles strongly oblique, the lower point of the angles in shape of a small tooth, posterior angles likewise dentiform, the basal sulcus deep and straight as well as the lateral perpendicular grooves, the surface impunctate; scutellum broad, triangular; elytra with some extremely minute punctures, only visible under a strong lens; the knees, tibiæ, and tarsi black, the rest of the underside and the legs flavous.

Hab. Paraguay.

A distinct little species on account of the shape of the thorax, which is not narrowed in front as in the majority of the species, and the comparatively robust antennæ; the general shape is also less ovate and convex.

LACTICA BREVICOLLIS, sp. n.

Elongate, moderately convex, testaceous; the antennæ (the basal joint excepted), the knees, tibiæ, and tarsi black; thorax one-half broader than long, impunctate, the basal sulcus deep and straight; elytra impunctate.

Length 4½–5 millim.

Head impunctate, the frontal elevations distinct and rather broad, the carina narrow and acute; eyes large, entire; antennæ extending beyond the middle of the elytra, black, the basal joint flavous, third joint distinctly shorter than the fourth; thorax only one-half broader than long, distinctly narrowed anteriorly, the sides straight, with a very narrow margin, the anterior angles

but very slightly oblique, the basal sulcus very deep and straight and placed at a proportionately long distance from the base, the disc entirely impunctate; elytra wider at the base than the thorax, not much convex and of parallel shape; below and the legs flavous, the apex of all the femora and the tibiæ and tarsi black.

Hab. Colombia, Peru, Venezuela.

The comparatively narrow thorax, entirely impunctate upper surface, the structure of the head (acute carina), and the black apex of all the femora seem to distinguish this from any similarly coloured species of *Lactica* with which I am acquainted; neither can I identify the insect with *L. bogotana* Harold, of which but a superficial description is given and which is described as 7 millim. long, with closely approached eyes and a microscopic but distinct punctuation.

LACTICA NIGRICORNIS, sp. n.

Broadly ovate, fulvous; the antennæ, the knees above, the tibiæ, and the tarsi black; thorax transverse, impunctate, the basal sulcus deep and straight; elytra minutely punctured in semi-regular rows.

Length 5 millim.

Of more broadly ovate and less convex shape than the majority of species, of a reddish-fulvous colour; the head impunctate, eyes not very large, entire, frontal elevations entirely obsolete, clypeus convex between the antennæ; labrum piceous, palpi black; the antennæ with rather short and robust joints, extending to about the middle of the elytra, black, the basal joint more or less fulvous below, second and third joints nearly equal; thorax twice as broad as long, slightly narrowed anteriorly, the lateral margins perfectly straight, the anterior angles oblique, not produced, surface impunctate, with a deep and straight basal sulcus; elytra gradually widened posteriorly, very finely punctured in irregular and closely approached rows, indistinct at the apex; below and the legs paler, the knees above, the tibiæ, and tarsi black; tibiæ clothed with fine yellow pubescence.

Hab. St. Catharina, Brazil.

Much larger than *L. tibialis* Oliv., with entirely black antennæ, the elytra with a fine and distinct punctuation; the general shape resembling that of *Haltica rufa* Oliv. Two exactly similar specimens are before me.

LACTICA GRACILICORNIS, sp. n.

Oblong-ovate, fulvous; the antennæ long and slender, black, the lower three joints flavous; thorax transverse, impunctate, the basal sulcus deep and sinuate, the sides anteriorly with a fovea; elytra extremely finely and closely punctured.

Length 2 millim.

Head with a few punctures near the eyes, the latter large, entire, frontal tubercles small and obsolete, carina narrow and feebly raised, palpi flavous; antennæ extending to the apex of

the elytra, black, the lower three joints flavous, basal joint elongate, the second and third nearly equal, the latter, however, much thinner, the following joints very elongate, the last three thinner than the preceding joints; thorax rather more than twice as broad as long, the sides very feebly rounded, the anterior angles not oblique, the disc impunctate with a transverse impression at the sides near the anterior angles, basal sulcus deep and sinuate, closely placed to the basal margin; elytra convex, with a very shallow depression below the base, extremely minutely and irregularly punctured; underside and the legs flavous.

Hab. Mexico.

Of this species I received two specimens from M. Deyrolle, which had been found in Mexican tobacco. The small size, very slender antennæ, the anterior thoracic fovea, and the entirely flavous legs will assist in its recognition.

LACTICA CARINATA, sp. n.

Entirely testaceous, of elongate shape; head with a transverse ridge; thorax impunctate, not very transverse, basal sulcus deep and straight; elytra not perceptibly punctured.

Length $4\frac{1}{2}$ millim.

Head impunctate; frontal elevations obsolete, replaced by a transverse ridge between the eyes; the latter very large, occupying the entire sides of the head; clypeus strongly and acutely raised between the antennæ; the latter extending beyond the middle of the elytra, entirely testaceous, the third joint one-half longer than the second, but much shorter than the fourth joint; thorax scarcely twice as broad as long, slightly narrowed anteriorly, the sides nearly straight, with a narrow reflexed margin, the anterior angles oblique, but not produced, the basal sulcus and the perpendicular grooves deep, the disc impunctate; elytra nearly parallel, impunctate; below and the legs coloured like the upper parts, the metatarsus of the posterior legs elongate.

Hab. Cayenne.

There will be no difficulty in distinguishing this species from its allies on account of the transverse ridge between the eyes and the unicolorous legs. I know only a single specimen of this species, which is in my collection.

LACTICA IMPRESSICOLLIS, sp. n.

Ovate, fulvous, the antennæ (the lower three joints excepted) black; thorax transverse, with an antemedial transverse depression at the sides, the basal sulcus deep and sinuate; elytra with a shallow depression below the base, impunctate; legs fulvous.

Length 4 millim.

Head deeply punctured near the eyes, the latter large, strongly emarginate, the intra-ocular space raised in two elevations; clypeus bluntly elevated; antennæ extending beyond the middle of the elytra, black, the lower three joints flavous, the second one-half shorter than the third joint, the others closely pubescent;

thorax twice as broad as long, the sides feebly rounded near the base, very slightly narrowed anteriorly, the anterior angles oblique, the basal sulcus deep and rather sinuate, the anterior portion of the thorax impressed with a transverse fovea at the sides, the surface impunctate; elytra widened towards the middle, feebly transversely depressed below the base, impunctate, their epipleuræ very broad and concave.

Hab. Bahia.

Amongst the unicolorous species, the present *Lactica* is distinguished by the raised intra-ocular space in shape of two blunt elevations, and by the antemedian fovea of the thorax.

LACTICA BAHIAENSIS, sp. n.

Narrowly oblong, entirely testaceous; thorax impunctate, the basal sulcus deep and very sinuate; elytra not perceptibly punctured.

Length 4 millim.

Head with a deeply punctured sulcus round the eyes, the latter large, feebly emarginate, frontal elevations only indicated; clypeus strongly convex between the antennæ; the latter extending below the middle of the elytra, entirely testaceous, the second joint one-half shorter than the third, the fourth longer than the preceding joint; thorax about twice broader than long, the sides straight, the anterior angles oblique, the basal sulcus deep and strongly bisinuate, the disc impunctate; elytra not perceptibly punctured.

Hab. Bahia.

I must separate this species from its unicolorous allies on account of the more than usually sinuate thoracic sulcus, in connection with the structure of the head.

LACTINA Harold.

LACTINA LÆVICOLLIS, sp. n.

Dark blue, the thorax nearly subquadrate, entirely impunctate; elytra extremely closely and subrugosely punctured, clothed with very short grey pubescence.

Length 6–7 millim.

Male. Head impunctate, the frontal elevations strongly raised, elongate and oblique, carina acute, labrum black; antennæ nearly extending to the apex of the elytra, dark blue, the third and fourth joints equal; thorax about one-half broader than long, the sides nearly straight, the anterior angles slightly produced outwards, the base with the usual deep, sinuate transverse sulcus, the surface entirely impunctate; elytra widened near the apex, extremely closely and rather finely punctured, the interstices very finely wrinkled and clothed with very short greyish hairs; epipleuræ broad, concave and glabrous; the male organ curved and like that of *L. glabrata*, but with the anterior cavity shorter and more ovate, the sides raised and with a blunt ridge within.

Hab. Peru.

I must separate this species from any other on account of the impunctate thorax, which even under the strongest lens shows no trace of any punctuation. Examples of both sexes are before me, and do not seem to vary except in the slightly broader thorax of the female.

LACTINA SEMIRUGOSA, sp. n.

Metallic green, glabrous above, below bluish; thorax subquadrate, finely punctured, the transverse sulcus deep; elytra widened below the middle, very closely and strongly punctured, the interstices more or less rugose.

Length 7 millim.

Head very finely transversely wrinkled, without punctures, the frontal elevations strongly raised, pyriform, carina acute; antennæ long and slender, metallic blue at the four or five basal joints, the rest black, third and fourth joints equal, shorter than the fifth; thorax about one-half broader than long, the sides nearly straight, very slightly narrowed anteriorly, the surface very finely but not very closely punctured, the basal sulcus deep and nearly straight, bounded laterally by a deep perpendicular groove; scutellum blackish; elytra widened below the middle, without basal depression, comparatively strongly and very closely punctured, with finely wrinkled interstices; below very sparingly pubescent.

Hab. Colombia.

I know of no other species of *Lactina* with such strongly punctured elytra in connection with the glabrous upper surface. The description is that of the male, in which the anterior tarsi are dilated, and the last abdominal segment has a central narrow groove; the female does not differ except in the more slender tarsi and the generally rather larger size.

LACTINA GLABRATA, sp. n.

Metallic dark blue, glabrous above; thorax one-half broader than long (♂), nearly impunctate, with deep sinuate sulcus; elytra very closely and distinctly punctured.

Length 6 millim.

Male. Head impunctate, the frontal tubercles strongly raised, oblique, the carina acute; the antennæ nearly extending to the apex of the elytra, metallic blue, the third joint slightly longer than the fourth and as long as the fifth joint; thorax one-half broader than long, the sides straight at the base, slightly rounded anteriorly, the anterior angles thickened, the surface with a deep sinuate sulcus, the anterior portion rather convex, very minutely and somewhat closely punctured as well as the base below the sulcus; scutellum small, impunctate; elytra convex, not widened posteriorly, attaining their greatest convexity at the middle, very closely and rather strongly punctured, the apex of each rounded, their epipleuræ concave, impubescent; below and the legs smooth, shining; the male organ curved, parallel, the apex rather blunt, with an elongate cavity.

Hab. Colombia, Venezuela.

I know of only one other described species which has an impubescent upper surface (*L. chalcoptera* Har.); but in that species the carina of the head is short and blunt, the thorax is impunctate, the elytra have traces of costæ and are cupreous in colour. In the female of the present species the antennæ are much shorter and the elytra show a slight depression below the base; the insect is also much more robust in shape.

DISONYCHA DECEMMACULATA, sp. n.

Black; thorax flavous, with four black spots; elytra strongly punctured, black, each with five flavous spots (2, 2, 1), the one near the scutellum curved; the femora and the abdomen flavous.

Length 4 millim.

Head with a deep punctured groove near the eyes, black, with a flavous mark on the vertex, the frontal elevations distinct, the clypeus strongly convex, flavous; labrum black; antennæ robust, black, the lower four joints flavous below, third joint slightly shorter than the fourth; thorax twice as broad as long, flavous, the sides straight, the anterior angles scarcely oblique, rather rounded, posterior angles oblique, the disc impunctate, with four small black spots placed transversely; elytra strongly and closely punctured, black, each with five yellow spots, one at the humeral callus, another in shape of a Ↄ near the scutellum, two round spots at the middle and a transverse one near the apex; the breast, the tibiæ and tarsi black; femora and abdomen flavous, the apex of the posterior femora black.

Hab. Pernambuco, Pery-Pery.

This species will be easily recognized by the strong elytral punctuation and the outwardly curved spot near the scutellum.

DISONYCHA ELONGATA, sp. n.

Elongate and subdepressed, testaceous, the terminal joints of the antennæ fuscous; thorax impunctate; elytra not perceptibly punctured; a very narrow sutural and a sublateral stripe and a broader longitudinal band at the disc, black.

Length 9 millim.

Head impunctate, the clypeus with an acutely raised central ridge; eyes reniform, rather deeply emarginate; antennæ extending to the middle of the elytra, rather robust, fuscous, the lower four joints testaceous, the fourth joint nearly twice as long as the third; thorax about one-half broader than long, the sides nearly straight with a narrow margin, the posterior angles strongly oblique, anterior angles obliquely truncate; scutellum black; elytra rather flattened, not perceptibly punctured, testaceous, very shining, the suture very narrowly and a slightly wider stripe close to the margins black, another much broader band extends from the middle of the base nearly to the apex; below and the legs testaceous, the apex of the posterior tibiæ obscure fuscous.

Hab. Venezuela.

This species closely resembles in coloration and pattern many others of the genus, but may be distinguished by the impunctate elytra, the width of their black stripes, the comparatively narrow and unspotted thorax, and the rather large general size of the insect.

DISONYCHA BREVICOLLIS, sp. n.

Oblong, pale testaceous, the antennæ (the basal joints excepted) and the tarsi black; thorax short and transverse, scarcely punctured; elytra closely and distinctly punctured, the sutural and lateral margins and a narrow obsolete discoidal stripe obscure pale fulvous.

Length 6 millim.

Head with a few punctures placed transversely between the eyes, the frontal elevations feebly raised; clypeus broad, testaceous, like the labrum and the rest of the head; eyes rather elongate; antennæ robust, black, the basal three joints flavous; thorax more than twice as broad as long, the sides nearly straight, the anterior angles produced obliquely outwards, the posterior angles oblique but not produced, the basal margin rounded, the disc with a few fine punctures; elytra closely and comparatively strongly punctured, the sutural and discoidal stripes very narrow and obsolete, the lateral margins more broadly marked with pale fulvous; below testaceous, the tarsi black.

Hab. Ventanas, Mexico.

This species, which was unknown to me during the publication of the Mexican Phytophaga in the 'Biologia Centr.-Amer.,' is readily distinguished by the shortness of the thorax, the more than usual strong elytral punctuation, and the narrowness and faint coloration of their stripes. Two specimens are in my collection.

DISONYCHA ANGULATO-FASCIATA, sp. n. (Plate XX. fig. 4.)

Flavous, the head with two, the thorax with five black spots; elytra impunctate, black, a transverse medially constricted band at the base, another at the middle, and a spot near the apex flavous; the apex of the femora and the tibiæ and tarsi black.

Length 4 millim.

Head with some deep punctures near the eyes, flavous, a spot on the vertex and another small spot between the eyes black, the latter rather large; carina strongly raised; antennæ robust, black, the lower four joints flavous, the basal two stained with black above, third and fourth joints equal; thorax twice as broad as long, the sides straight, very narrowly margined, the anterior angles oblique, the disc impunctate, flavous, with five small black spots (2, 3) placed transversely, the outer ones of the second row the largest, the base with an obsolete transverse sulcus; scutellum black; elytra not perceptibly punctured, with alternate transverse flavous and black bands of angulate shape, the sutural and lateral

margins likewise black; below flavous, the anterior legs entirely, the apex of the femora and the tibiæ and tarsi black.

Hab. Pernambuco, Serra de Communaty.

This little species resembles somewhat the well-known *D. austriaca* Schauf., but the design of the elytra is different and consists of two flavous and two black transverse angulate bands and a flavous spot at the apex: the first of these light bands is placed somewhat obliquely at the base, leaving the humeral callus black, the second is situated at the middle and is strongly constricted medially.

CACOSCELIS GUIANAENSIS, sp. n.

Flavous, the vertex of the head, the antennæ, the femora above, and the tibiæ and tarsi black; thorax finely punctured, with two black spots; elytra metallic green, strongly and closely punctured, the lateral margins narrowly flavous; tibiæ not emarginate.

Length 10–12 millim.

Hab. British Guiana.

I am obliged to separate this species from the well-known *C. marginata* Fab., which it completely resembles in coloration, on account of the entire tibiæ, the same parts in *C. marginata* having a very distinct emargination. Other less striking differences are to be found in the rather stouter antennæ of the present species, in the more transversely shaped thorax, which is closely and finely punctured at the sides and has two large well-separated blackish spots, with sometimes a smaller intermediate one. Fabricius's species is generally found in Brazil. In the present insect the vertex of the head is likewise black, which I have not found to be the case in any specimen of the allied species. *C. compta* Erichs. has the sutural margins flavous as well as the lateral ones. There are four specimens before me.

CACOSCELIS TIBIALIS, sp. n.

Below flavous, above fulvous, the antennæ, tibiæ, and tarsi black or piceous; thorax transversely subquadrate, impunctate, obsoletely sulcate; elytra finely and closely punctate-striate.

Length 7–8 millim.

Of elongate and nearly parallel shape, the head impunctate, fulvous, the frontal elevations transverse, bounded behind by a deep groove; clypeus rather strongly raised between the antennæ, its anterior margin straight; labrum flavous, with a few punctures; terminal joint of the palpi acutely pointed; antennæ extending slightly beyond the middle of the elytra, black, slender, the third and fourth joints more slender than the following ones but not longer, basal joint more or less fulvous below; thorax about one-half broader than long, of equal width, the sides rounded, the anterior angles somewhat oblique, the lateral margins accompanied by a depression, the base with a shallow transverse groove; the disc impunctate, fulvous, shining; scutellum triangular, impunctate; elytra finely punctured in closely approached, rather

regular rows, their epipleuræ very broad, continued to the apex; below flavous, the tibiæ and tarsi black (sometimes only infuscate), the posterior tibiæ with a small spur, the others unarmed; prosternum narrow, anterior cavities open.

Hab. Espirito Santo, Brazil.

What I take to be the female of this species differs in having a rather broad reflexed lateral margin to the elytra, and the upper surface of a more pronounced fulvous; otherwise there is no difference of any importance. The species differs from *C. flava* Clark and *C. testacea* Cl. in the general smaller size, the arrangement of the elytral punctuation, and in the black tibiæ and tarsi. In the female the elytral interstices are more or less costiform. The species, like several others placed in this genus, has entire, not emarginate tibiæ.

Cacoscelis varipes, sp. n.

Below black; head and thorax fulvous, impunctate; elytra dark greenish, opaque, minutely punctured; the anterior and intermediate femora fulvous, the tibiæ and tarsi and the posterior femora black.

Length 10 millim.

Head extremely minutely punctured when seen under a strong lens, fulvous, the frontal elevations subquadrate, rather strongly raised; clypeus with a highly raised blunt ridge between the antennæ, the last-named organs black, the basal joint fulvous, the terminal two joints very elongate, much longer than the preceding ones; thorax nearly twice as broad as long, slightly narrowed anteriorly, the sides feebly rounded, with a rather broad flattened margin, the base with a shallow sulcus, not extending to the sides, the anterior angles slightly thickened, the surface impunctate, fulvous; scutellum broad, black; elytra slightly wider at the base than the thorax, rather convex, of opaque greenish colour, very finely punctured, with a narrow reflexed lateral margin, their epipleuræ very broad and concave; below clothed with grey pubescence, black, the anterior and intermediate femora fulvous; tibiæ not emarginate at the apex, the first joint of the posterior tarsi as long as the following joints together.

Hab. Brazil.

Of this species, which differs in coloration from any of its allies, a single specimen is in my collection, without any exact locality. It is somewhat allied in colour to *C. opacipennis* Jac., from Colombia, but differs entirely in the shape of the thorax and the colour of the underside and legs.

Cacoscelis cæruleipennis, sp. n.

Pale fulvous, the antennæ (the first joint excepted) black; head and thorax impunctate; elytra dark violaceous blue, finely and closely punctured, with traces of longitudinal sulci.

Length 7 millim.

Head fulvous, entirely impunctate, the frontal elevations

distinct, eyes oblong; antennæ extending beyond the middle of the elytra, black, the basal joint fulvous, the third and following two joints elongate, equal; thorax strongly transverse, slightly narrowed anteriorly and at the base, the sides rounded anteriorly, with a very narrow margin, the surface impunctate, light fulvous; scutellum of similar colour; elytra very distinctly, closely, and somewhat rugosely punctured, with some very obsolete longitudinal sulci, dark violaceous blue; below and the legs pale fulvous, the tarsi infuscate.

Hab. Brazil.

Of this species I know only a single specimen, which is in my collection. It is allied to *C. violaceipennis* Clark, but the elytra are without the flavous lateral margins, the tibiæ are fulvous, not black, and the antennæ have the basal joint fulvous only.

OCNOSCELIS BOLIVIANA, sp. n.

Testaceous; antennæ greenish black; head and thorax greenish or fulvous, nearly impunctate; elytra closely and distinctly punctured, testaceous or obscure fulvous, the base broadly and the sides narrowly metallic green.

Length 5 millim.

Male. Of ovate and depressed shape, the head strongly punctured at the vertex, more or less metallic greenish, the frontal tubercles very strongly developed, pyriform; antennæ as long as the body, blackish, the basal joint strongly thickened, the third and fourth equal, terminal joints very elongate and slender; thorax comparatively long, scarcely one-half broader than long, the sides but feebly rounded, with a narrow flattened margin, the posterior angles acute, the anterior angles obsoletely thickened, the disc nearly impunctate and smooth, more or less metallic green, with the sides narrowly fulvous or entirely of the latter colour; scutellum blackish; elytra closely and rather strongly punctured, obscure fulvous, the base more or less metallic green, this colour also extending down at the sides to about the middle of the elytra; below and the legs testaceous, the tibiæ and tarsi generally darker, the intermediate tibiæ of the male strongly curved.

Hab. Bolivia.

Like the other three species of this genus, the present one seems rather variable in regard to coloration, but in seven specimens before me the colour of the elytra is constant. The shape of the thorax and the impunctate disc of the latter distinguish the species from its allies. In the female the antennæ are shorter, the thorax is more transverse and is finely punctured.

NEPHRICA Harold.

This genus has been established by von Harold on a species having the general appearance of a *Disonycha* or *Asphæra*, but in which the eyes are reniform and emarginate, the sides of the thorax with a narrow margin, and the tibiæ without any emargi-

nation near the apex. All these characters are, however, not wanting in many species of *Disonycha*, and intermediate stages frequently occur in which it is impossible to say to which genus to refer the species. *Nephrica* is therefore not a well-founded genus, and it is impossible to fix the limit between this and *Disonycha*. Nevertheless I have left the question in its present state, and described all those species contained in my collection in which the kidney-shaped eyes and other details peculiar to von Harold's genus are well marked, so that there will be little difficulty in recognizing these forms.

NEPHRICA BOLIVIANA, sp. n.

Pale flavous, the base of the head, the antennæ, underside, and legs black; thorax impunctate; elytra extremely minutely punctured, yellowish white, a broad transverse band at the base and another below the middle, not extending to the lateral nor apical margins, metallic green.

Length 6 millim.

Head piceous at the base, impunctate, the lower portion nearly white, the carina distinct and broad; antennæ not extending to the middle of the elytra, piceous, the basal joint flavous below; thorax twice as broad as long, the sides very feebly rounded, with a narrow margin, the anterior angles truncate, the posterior slightly truncate, the surface impunctate, yellowish white; scutellum black; elytra nearly impunctate or with some extremely minute punctures at the sides, metallic green, this colour not quite extending to the lateral nor apical margins, and divided at the middle by a narrow transverse flavous band; below and the legs black (in immature specimens stained with flavous).

Hab. Bolivia.

Allied to *N. didyma* Illig. and *N. kirschi* Har., but differing in the design and colour of the elytra. In the above given description I have taken the green colour for that of the ground, but in the diagnosis the pale colour.

NEPHRICA MACULIPENNIS, sp. n. (Plate XX. fig. 8.)

Below black, as well as the antennæ and legs; head and thorax flavous, the latter with five small black spots (4, 1); elytra closely punctured, testaceous, the basal margin, the shoulders, a narrow lateral stripe, connected with a broad transverse band below the middle, and a round spot near the latter part, metallic green.

Length 7 millim.

Head sparingly punctured near the eyes, flavous, the extreme vertex black; carina acute, labrum and palpi black; antennæ short, not extending to the middle of the elytra, black, the lower three joints testaceous below, third joint shorter than the fourth, terminal joints slightly thickened; thorax twice as broad as long, the sides feebly rounded, the anterior angles oblique, the surface impunctate, flavous, with four small piceous spots placed transversely anteriorly, and another spot at the middle near the base;

scutellum black; elytra very closely and strongly punctured, testaceous, with the basal and sutural margins, a humeral spot, and a narrow submarginal stripe metallic green; this latter stripe joins a transverse broad band before the apex, while a similarly coloured spot is placed at the middle of the disc on each elytron; below and the legs black, finely pubescent.

Hab. Rio Grande do Sul, Brazil.

NEPHRICA SANGUINOLENTA, sp. n. (Plate XX. fig. 10.)

Below fuscous, above dark red; thorax obsoletely sulcate, impunctate; elytra very minutely punctured, bright red, the disc with a large subquadrate yellowish patch.

Length 8 millim.

Head impunctate, with the exception of a single puncture near the eyes, the latter kidney-shaped, large; clypeus thickened, but rather broad between the antennæ; the latter extending to the middle of the elytra, dark fulvous, the third joint twice as long as the second and as long as the fourth; thorax rather more than twice as broad as long, the sides nearly straight, slightly obliquely narrowed towards the apex, with a distinct reflexed margin, anterior angles thickened, slightly produced outwards, the disc impunctate, very obsoletely sulcate near the base, dark reddish; elytra closely and extremely minutely punctured, of nearly blood-red colour, the latter interrupted at the middle by a large subquadrate yellowish patch, the anterior edge of which extends rather nearer towards the base than the posterior one towards the apex; below and the legs dark fulvous.

Hab. Espirito Santo, Brazil.

A single specimen of this well-marked species is contained in my collection.

NEPHRICA FULVICORNIS, sp. n.

Flavous, the antennæ and the legs fulvous, the breast and the posterior femora black; head and thorax impunctate; elytra bluish black, a transverse band at the middle, the apex and the lateral margins flavous.

Length 5 millim.

Head impunctate, pale flavous; eyes large, sinuate, frontal tubercles distinct; clypeus slightly raised, triangular; antennæ robust, fulvous, the third joint distinctly shorter than the fourth; thorax more than twice as broad as long, the sides with a rather broad flattened margin, anterior angles obtusely thickened, the disc impunctate, yellowish white; scutellum black; elytra perceptibly punctured on the pale portion only, bluish black, this colour interrupted by a transverse flavous band at the middle which does not quite extend to the suture, but is connected with the similarly coloured lateral margin, the apex likewise pale flavous; below flavous, the sides of the breast and the posterior femora black.

Hab. Amazonia.

This species differs from *N. brasiliensis* and *N. boliviana* in the flavous apex of the elytra and in its general smaller size, also in the colour of the underside and legs.

Nephrica paraguayensis, sp. n.

Dark fulvous; thorax with rounded sides, impunctate; elytra very closely and finely punctured, flavous, the basal and sutural margin, a narrow transverse band before and another below the middle, dark fulvous.

Length 6 millim.

Head finely punctured between the eyes, the frontal elevations obsolete, the carina broad; antennæ fulvous, the third and fourth joints equal; thorax twice as broad as long, the sides strongly rounded and broadly margined, the anterior angles obtusely rounded, the surface impunctate, fulvous; elytra closely and finely punctured, flavous, the base with a narrow fulvous band extending to the shoulders, two other medially constricted bands, one before, the other below the middle, extend across the elytra but do not reach the lateral margins; below and the legs dark fulvous.

Hab. Paraguay.

Two exactly similar specimens are before me, which resemble greatly in their markings certain species of the genus *Homophœta*.

Nephrica inclusa, sp. n. (Plate XX. fig. 5.)

Yellowish white, the antennæ, tibiæ, and tarsi black; thorax impunctate, the sides straight; elytra extremely finely punctured, the basal and sutural margins, a transverse band before the middle enclosing a basal spot of the ground-colour, and another transverse band before the apex, reddish fulvous.

Length 7 millim.

Head yellowish white, impunctate, the vertex with a black band; the frontal tubercles, the labrum, and palpi black; clypeus very broad; antennæ black, the third and fourth joints equal; thorax with the sides nearly straight, the anterior angles broadly truncate, the surface impunctate, yellowish white; scutellum black; elytra extremely finely and rather closely punctured, pale flavous, the base and a transverse band before the middle, connected at the shoulders by a narrow longitudinal stripe, fulvous, another narrow band below the middle and the suture narrowly of the latter colour; below and the legs flavous, the posterior femora above and the tibiæ and tarsi black.

Hab. —— ?

This species, of which I unfortunately do not know the locality, but which is probably from Brazil, much resembles *N. paraguayensis*, but has nearly white upper and under sides, and the thorax is of totally different shape, having straight instead of rounded sides, the elytral punctuation also is much finer.

Nephrica claveri, sp. n. (Plate XX. fig. 9.)

Head, the underside, and the posterior femora black; the

antennæ, thorax, and the legs flavous; thorax impunctate; elytra extremely finely punctured, black, a transverse band before and another one below the middle flavous.

Length 6 millim.

Head black, with a few punctures near the eyes, the frontal tubercles and the carina acutely raised; antennæ extending to the middle of the elytra, flavous, the basal three joints stained with black above; thorax of the usual shape, the sides feebly rounded at the middle, the surface impunctate, flavous, the base with a rather well-marked transverse sinuate sulcus; scutellum black; elytra extremely minutely punctured, black, with a slightly curved flavous transverse band at the middle and another near the apex, their epipleuræ, the underside, and the posterior femora black; the anterior legs, the posterior tibiæ, and all the tarsi flavous; tibiæ entire, not emarginate.

Hab. Colombia, Ibague (*Frère Claver*).

Of this very distinct species I received a specimen from Frère Sebastien at St. Génis Laval, which was obtained by Frère Claver, an ardent explorer of parts of Colombia.

NEPHRICA STAUDINGERI, sp. n. (Plate XX. fig. 11.)

Flavous, the base of the head, the antennæ and legs fulvous; thorax impunctate, flavous; elytra dark fulvous, impunctate, a round spot at the base, a transverse band at the middle, another near the apex, and the lateral margins narrowly, flavous.

Length 5 millim.

Head with one or two deep punctures near the eyes, the vertex piceous, the lower portion flavous, frontal elevations obsolete, the carina distinct; labrum piceous; the antennæ dark fulvous, the fourth joint slightly longer than the third; thorax with the sides nearly straight, the anterior angles truncate but not produced, the base with an obsolete transverse sulcus, the surface impunctate, flavous; scutellum flavous; elytra entirely impunctate, dark fulvous, each elytron with a round flavous spot at the base, a slightly curved transverse band at the middle, and another one near the apex, the lateral margins likewise very narrowly flavous as well as the outer margin of the elytral epipleuræ; below flavous, the legs dark fulvous.

Hab. Amazonia.

This little species very much resembles *Disonycha austriaca* Schauf., but the elytra are fulvous, not black, and have flavous lateral margins.

NEPHRICA TERMINATA, sp. n.

Black, the thorax testaceous, impunctate, the disc black; elytra very finely and closely punctured, testaceous, the basal margin and a triangular apical spot black.

Length $5\frac{1}{2}$ millim.

Head impunctate, with the exception of a deep puncture near the eyes, black, shining; the base of the antennæ and the clypeus

flavous, labrum and palpi black; antennæ rather slender, black, all the joints, with the exception of the second, nearly equal; thorax with the sides straight, the anterior angles broadly truncate and rather produced, the surface with the usual obsolete transverse sulcus near the base, impunctate, testaceous, the disc with a triangular black band or spot at the middle; scutellum black; elytra with the base narrowly black, this colour extending to the shoulders, the apex with another triangular black spot; below and the legs black, the base of all the femora flavous.

Hab. Upper Amazons.

NEPHRICA BRASILIENSIS, sp. n. (Plate XX. fig. 6.)

Pale fulvous, the head, antennæ, and the legs black; thorax yellowish white, impunctate, scutellum black; elytra scarcely perceptibly punctured, black, shining, the lateral margins and a large transverse patch at the middle yellowish white.

Length 8 millim.

Head black, with a single puncture near the eyes, the latter very large, kidney-shaped; clypeus flavous, triangularly raised, labrum and palpi black; antennæ rather short and robust, black, the third joint twice as long as the second and nearly equal to the fourth joint, intermediate joints slightly widened; thorax nearly three times broader than long, slightly narrowed in front, the sides nearly straight, with rather broad, strongly reflexed lateral margins; anterior angles obtusely thickened, the surface impunctate, very shining, nearly white, with a very obsolete sulcus near the base; elytra convex, widened towards the middle, with narrow lateral margins, nearly impunctate, shining black, this colour interrupted at the middle by a large transverse yellowish patch, which does not quite extend to the suture, but is connected at the sides with the similarly coloured lateral margin; below pale fulvous, the legs black, the extreme base of the posterior femora fulvous.

Hab. Rio Janeiro.

A rather large and convex species, well distinguished by its coloration.

NEPHRICA IMITANS, sp. n.

Testaceous, the antennæ, tibiæ, and tarsi black; thorax impunctate, obsoletely sulcate near the base; elytra impunctate, a broad sutural and discoidal band and a very narrow sublateral stripe black.

Length 7 millim.

Head impunctate, the frontal tubercles obsolete, the carina acutely raised, eyes broadly emarginate; antennæ black, the basal two joints testaceous below, the fourth joint longer than the third; thorax of usual transverse shape, the sides very feebly rounded at the middle, the anterior angles strongly obliquely truncate, the posterior margin emarginate in front of the scu-

tellum; the disc impunctate, testaceous, very obsoletely transversely sulcate near the base; scutellum black, margined with testaceous; elytra rather broadly ovate, impunctate, with a broad sutural and a very narrow sublateral black band, the disc with another broad band not quite extending to the apex, their epipleuræ testaceous, black at their inner portion near the base; below and the legs testaceous, the tibiæ and tarsi blackish.

Hab. Peru.

Shorter and broader than *Disonycha elongata*, the sutural band much wider and the antennæ and legs differently coloured; the thorax is also more transverse in shape and the posterior angles less obliquely cut; the elytral pattern resembles entirely that of many species of *Disonycha*, but the eyes are distinctly reniform and the thorax is of different shape.

NEPHRICA NIGROFASCIATA, sp. n.

Black, the apical joints of the antennæ and the legs flavous; thorax impunctate, flavous; elytra very closely and distinctly punctured, black, a subsutural and a sublateral narrow band, connected at the apex, flavous, apex of the posterior femora black.

Length 8 millim.

Head black, shining, impunctate, with the exception of a few punctures near the eyes, the latter very large, reniform; antennæ with the basal and the last four joints flavous, the others black; thorax twice as broad as long, the sides straight, the angles obliquely truncate, the surface flavous, impunctate; elytra closely, strongly, and irregularly punctured, flavous, the sutural and lateral margins narrowly black, the disc occupied by a broad longitudinal band which does not extend to the apex; below black, the femora and tibiæ flavous, the apex of the posterior femora and all the tarsi black.

Hab. Espirito Santo, Brazil.

A large species, easy of recognition on account of the colour of the antennæ and strong elytral punctuation, and resembling much a species of *Disonycha*, from which the shape of the eyes will distinguish it; the basal margin of the thorax is scarcely oblique at the posterior angles and altogether different in shape than in *Disonycha*.

NEPHRICA UNIFASCIATA, sp. n. (Plate XX. fig. 7.)

Black, the thorax fulvous, impunctate, obsoletely sulcate; elytra black, shining and impunctate, a round spot at the base of each and a transverse band near the apex white; abdomen fulvous.

Length 6 millim.

Head black, with a single deep puncture near the eyes, the latter large, reniform, frontal tubercles obsolete, carina strongly raised; antennæ black, the second and third joints small, nearly equal, the fourth elongate; thorax scarcely twice as broad

as long, the sides straight, not narrowed anteriorly, with a very narrow margin, anterior angles feebly truncate, the surface impunctate, fulvous, with an obsolete shallow sulcus near the base, posterior angles scarcely oblique; scutellum black; elytra very shining, black, slightly depressed below the base, not perceptibly punctured, a round spot, placed at the middle of the base, and a transverse, very regular band near the apex yellowish white; below and the legs black; abdomen fulvous.

Hab. Peru.

A very distinct species on account of its coloration.

Systena clarki, sp. n.

Testaceous; thorax transversely subquadrate, impunctate; elytra dark fuscous, the basal margin narrowly testaceous, the surface impunctate.

Length 3 millim.

Head impunctate, testaceous or pale fulvous, the frontal elevations distinct, subquadrate; antennæ entirely flavous, the third joint not longer than the fourth, the terminal joints slightly thickened; thorax about one-half broader than long, the sides rounded at the middle, distinctly constricted at the base, the angles acute, the surface with a shallow but distinct basal sulcus, impunctate, obscure testaceous or fulvous; scutellum flavous; elytra wider at the base than the thorax, entirely impunctate, dark fuscous or nearly black, the base narrowly testaceous; below and the legs testaceous; prosternum extremely narrow, the posterior femora but moderately thickened, with a piceous short streak above near the apex, the metatarsus of the posterior legs elongate.

Hab. Colombia.

There are three specimens of this species contained in my collection; the thorax is of rather convex shape, more so than is generally the case in this genus, and the first joint of the posterior tibiæ is proportionately long, but there is nothing to separate the species generically.

Systena punctatissima, sp. n.

Below black, above pale testaceous, antennæ fuscous; the head remotely, the thorax and the elytra very closely and finely punctured.

Length 4 millim.

Head distinctly but not closely punctured, the frontal tubercles feeble, the labrum piceous; antennæ rather stout, entirely pale fulvous, the joints slightly stained with fuscous above, terminal joints slightly stouter and shorter than the preceding ones; thorax one-half broader than long, the sides distinctly rounded at the middle, the anterior angles rather obsolete, the surface very closely punctured at the sides, less closely at the middle, the basal sulcus very feeble; elytra with a slight transverse

depression below the base, punctured like the thorax and of the same colour, the suture slightly infuscate; below black, legs testaceous, the posterior tibiæ deeply channelled at the apical portion and also emarginate.

Hab. La Plata.

Of this very distinct species I possess two specimens; in one of these the basal joint of the antennæ and the apex of the others is more distinctly marked with fuscous.

SYSTENA BRASILIENSIS, sp. n.

Testaceous, the antennæ (the basal joints excepted) black; thorax very minutely punctured, the sides with or without a black stripe; elytra extremely finely and closely punctured, black, the lateral and apical margins narrowly testaceous; abdomen black.

Length 5 millim.

Head impunctate, testaceous or flavous, the frontal elevations feebly raised, clypeus rather depressed anteriorly, scarcely separated from the face; antennæ not extending to the middle of the elytra, black, the lower four joints testaceous below, the terminal five joints distinctly shorter than the preceding ones; thorax of usual shape, the sides straight at the base, slightly rounded anteriorly, the anterior angles obtuse, the basal sulcus shallow but distinct, slightly sinuate, the surface with a few scarcely perceptible punctures, testaceous, the sides with a narrow black band; scutellum black; elytra with an obsolete depression below the base, very closely and finely punctured, black, the lateral margins narrowly and the apical one more broadly pale testaceous; below and the legs testaceous, the abdomen black, the posterior femora black at the apex.

Hab. St. Catharina, Espirito Santo, Brazil.

There are six specimens of this distinct species before me, in some of which the lateral thoracic stripe is more or less or entirely obliterated. The species may be distinguished from similarly coloured varieties of *S. variabilis* Jac., from Panama, by the black abdomen, the shorter antennæ, the more distinctly marked thoracic sulcus, and the black apex of the posterior femora.

SYSTENA ABBREVIATA, sp. n.

Below black, basal joints of the antennæ fulvous, lower part of the face flavous; thorax finely punctured, testaceous, with a transverse black band; elytra minutely punctured, testaceous, a subsutural and a sublateral stripe, abbreviated behind, black; legs testaceous.

Length 5 millim.

Head very finely wrinkled at the vertex, the latter piceous or black, the lower portion flavous; antennæ piceous, the lower four joints flavous, fourth joint longer than the third; thorax twice as broad as long, the sides feebly rounded before the middle,

narrowly emarginate, the anterior angles obtuse, posterior angles distinct, the base with a narrow transverse sulcus, the disc scarcely perceptibly punctured and wrinkled, black, all the margins narrowly flavous; scutellum black; elytra sculptured like the thorax, the fine punctures closely placed, the ground-colour flavous or testaceous, a rather broad longitudinal stripe near the suture, and another narrower one near the lateral margins, both abbreviated behind, black.

Hab. Puebla, Mexico.

Of this species, which seems to be very rare, as I did not meet with it in the numerous collections I had before me when working out the Central American fauna, I have two exactly similar specimens now: they differ from the other species in the black thoracic band, the two posteriorly abbreviated elytral stripes, and the black underside; of the stripes, the subsutural one is of the same width as that of the following flavous space, but the lateral one is narrower. *D. discicollis* Clark has a black head, differently coloured legs and elytra, the latter are black with a discoidal flavous stripe.

OXYGONA BRASILIENSIS, sp. n.

Testaceous or pale flavous, the antennæ piceous; thorax impunctate, not strongly transverse, the angles acute; elytra finely and closely punctured.

Length 6 millim.

Head broad, impunctate, without any foveæ, the frontal elevations strongly raised; the clypeus triangular; the antennæ piceous or fuscous, nearly extending to the end of the elytra, the third and following joints elongate, equal, terminal joints shorter; thorax not much more than one-half broader than long, the sides rather strongly rounded anteriorly, all the angles acute, the anterior ones slightly oblique but scarcely produced, the surface smooth and shining, with a narrow margin at all the sides; scutellum more or less fuscous; elytra extremely closely and rather finely punctured, the apex nearly impunctate; below and the legs testaceous, the metatarsus of the posterior legs elongate, the prosternum extremely narrow, the last abdominal segment of the male triangularly emarginate at the apex, with a narrow central groove.

Hab. Espirito Santo, Brazil.

I must separate this species from *O. acutangula* Chev., on account of the much longer and much less transversely shaped thorax, which is very obvious when the two insects are compared in both sexes. *O. luridulus* Cl. and *O. simplex* Cl. have both flavous antennæ; the former has also a medial fovea on the head, but what Clark meant by a short, deep, and broad medial marking on the head, of which he says nothing in his description, it is difficult to understand. Two specimens of the present species are in my collection.

OXYGONA NIGRICOLLIS, sp. n.

Black, head and thorax impunctate; elytra pale flavous, nearly impunctate.

Length 5–6 millim.

Head entirely impunctate, with an oblique depression above the eyes, the frontal tubercles strongly raised, the carina short and broad; antennæ black, extending beyond the middle of the elytra, the third and the following two joints very elongate, the others shorter; thorax more than twice as broad as long, the sides subangulately rounded before the middle, strongly narrowed at the base, with a broad reflexed margin, the anterior margin accompanied by a narrow sulcus, the disc entirely impunctate, shining, black; scutellum black; elytra pale flavous, extremely minutely punctured; below and the legs black.

Hab. Espirito Santo, Brazil.

This typical *Oxygona*, of which three specimens are before me, is well distinguished by its system of coloration.

CREPIDODERA FLAVOMACULATA, sp. n.

Piceous, above black, the basal joints of the antennæ and the legs (the posterior femora excepted) testaceous; thorax opaque, minutely punctured and granulate, feebly transversely sulcate; elytra very closely punctate-striate, piceous, the humeral callus and the apex flavous.

Length $2\frac{1}{2}$ millim.

Head entirely impunctate, black, the frontal elevations obsolete, clypeus convex between the antennæ, labrum flavous; antennæ extending beyond the middle of the elytra, testaceous, the terminal joints more or less darkened, second and third joints of equal length, shorter than the fourth, terminal joints thickened; thorax subquadrate, one-half broader than long, the sides nearly straight, the angles distinct, the surface opaque, finely punctured and minutely granulate, the basal sulcus feeble, not extending to the sides, the space below it also distinctly punctured; scutellum black, impunctate; elytra wider at the base than the thorax, extremely closely punctured in irregular rows, the apex much more finely punctate, the disc blackish, the shoulders with a small flavous spot, the apex more or less broadly of the latter colour, the space along the suture somewhat depressed; below piceous, the legs testaceous or flavous, the posterior femora piceous, their metatarsus as long as the two following joints together, all the tibiæ with a small spine, prosternum very narrow; the anterior coxal cavities closed.

Hab. Concepcion, Talcahuano, Chili.

The thorax in this species is of an opaque, silky appearance and the sulcus but feebly impressed, although distinct. I cannot refer this insect to any of the species described by Philippi from the same country.

CREPIDODERA (CHALCOIDES ?) ERICHSONI, sp. n.

Greenish-æneous, above metallic greenish-cupreous, antennæ flavous; thorax convex, finely and closely punctured, the basal sulcus indistinct, the lateral grooves deep; elytra with deep basal depression, distinctly and regularly punctate-striate, tibiæ more or less fulvous.

Length 3 millim.

Of rather broadly ovate and convex shape, the head impunctate, with the exception of a few fine punctures near the eyes, the latter with oblique grooves from the inner margin to the middle of the head, the frontal tubercles obsolete, the carina strongly raised, terminal joint of the palpi acute and slender; the antennæ rather long, flavous, the third joint very slightly shorter than the second, the fourth and following joints more elongate, terminal ones slightly thickened; thorax transversely convex, the sides nearly straight, the anterior angles oblique, slightly thickened, the basal margin sinuate near the scutellum, rather broadly produced at the middle, the basal sulcus feeble at the middle, more deeply impressed at the sides, slightly sinuate, limited laterally by deep, somewhat curved, perpendicular grooves, the disc strongly convex, closely and finely punctured; scutellum small, blackish; elytra scarcely wider at the base than the thorax, the basal portion rather strongly raised, bounded by a transverse depression, the disc convex, subcylindrical, finely and regularly punctate-striate, metallic green with coppery reflections; below greenish-æneous, distinctly punctured, the legs piceous, the tibiæ obscure fulvous at the base, tarsi blackish, the first joint of the posterior tarsi as long as the following two joints together; prosternum rather broad; coxal cavities closed.

Hab. Peru.

The single specimen of this species contained in my collection does not quite agree with any of the genera allied to *Crepidodera*, on accountof the produced median lobe of the thorax, which gives the latter quite a different appearance from that of the other species; this lobe is not pointed but strongly rounded, and the species ought perhaps to be placed in a special genus, but this may be deferred until more similarly structured species turn up.

CREPIDODERA MAGISTRALIS, sp. n.

Rufous, the antennæ (the basal joints excepted) and the tibiæ and tarsi black; thorax transverse, impunctate, with deep basal sulcus; elytra metallic greenish, very closely semi-punctate-striate.

Length 7 millim.

Head impunctate, frontal tubercles acute, carina short; antennæ extending to about the middle of the elytra, black, the lower three joints fulvous, the third joint shorter than the fourth; thorax about two-thirds as broad as long, the sides rounded, the anterior angles slightly thickened and produced, the basal sulcus deep and slightly sinuate, bounded at the sides by a perpendicular

groove, the surface, like the head, rufous and impunctate; scutellum of the latter colour; elytra greenish-æneous, with very closely approached and irregular rows of rather fine punctures, which are evenly distributed over the entire surface; below rufous, the abdomen paler, the tibiæ and tarsi more or less black; the prosternum rather broad, elongate.

Hab. Peru.

I know only a single specimen of this large species, which seems allied to *C. consularis* Har. from Colombia, but differs in the colour of the underside, the different comparative length of the joints of the antennæ, and the non-continued thoracic sulcus.

NASIGONA, gen. n.

Body elongate; antennæ filiform; lower portion of the face concave, the clypeus not separated; thorax transverse, the anterior angles oblique, the surface obsoletely sulcate near the base; elytra closely punctate-striate, their epipleuræ broad, concave, the anterior and intermediate tibiæ unarmed, posterior tibiæ with a small spine, non-sulcate, the metatarsus of the posterior legs as long as the following joints together, claws appendiculate; prosternum narrowly elongate; the anterior coxal cavities closed.

The genus here proposed is allied to *Oxygona*, *Nasidia* Har., and *Systena*, but differs from all of them in the structure of the head, which at its lower portion resembles that of some genera of Longicornia or of *Loxoprosopus* among the Halticidæ; the structure of the antennæ and the shape of the thorax differ likewise from *Nasidia*, and the punctate-striate elytra from *Oxygona*. From *Systena* the genus may be separated by the structure of the head and the very elongate joints of the antennæ, as well as by the punctate-striate elytra.

NASIGONA PALLIDA, sp. n. (Plate XX. fig. 12.)

Entirely pale testaceous; antennæ black, the apical three joints testaceous, head and thorax impunctate; elytra strongly punctate-striate, the punctures nearly obsolete at the apex, a spot near the scutellum and another near the apex piceous.

Var. Elytra without spots.

Length 5 millim.

Head entirely impunctate, testaceous, the frontal elevations raised anteriorly and divided by an elongate fovea; clypeus forming a single piece, perpendicular, with a feeble central and lateral ridge, the anterior edge likewise narrowly raised; labrum large, apex of the mandibles black; antennæ slender, all the joints, with the exception of the second, very elongate, the basal one and the last three joints testaceous, the others black; thorax twice as broad as long, the sides distinctly constricted at the base, rounded anteriorly, the anterior angles oblique, the surface impunctate; scutellum rather broad, impunctate; elytra wider at the base than the thorax, the base slightly raised, strongly punctured in closely approached rows, the interstices more or less distinctly

longitudinally sulcate and slightly rugose or wrinkled, also more or less distinctly punctured.

Hab. Chanchamayo, Peru.

Of the spotted form, a single specimen is before me; these spots are nearly round, one is placed at the base near the scutellum, the other in a line near the apex. I look upon this specimen as the normal form, although four others, contained in my collection, have no elytral spots; there are no other differences between the two forms.

EXPLANATION OF PLATE XX.

Fig. 1. *Lactica costatipennis*, p. 175.
2. „ *seminigra*, p. 176.
3. „ *bicolorata*, p. 177.
4. *Disonycha angulato-fasciata*, p. 188.
5. *Nephrica inclusa*, p. 194.
6. „ *brasiliensis*, p. 196.
7. „ *unifasciata*, p. 197.
8. „ *maculipennis*, p. 192.
9. „ *claveri*, p. 194.
10. „ *sanguinolenta*, p. 193.
11. „ *staudingeri*, p. 195.
12. *Nasigona pallida*, p. 203.

March 18, 1902.

W. T. Blanford, Esq., LL.D., F.R.S., Vice-President, in the Chair.

A series of mounted specimens of Insects reared in the Insect-house during the past year was laid upon the table, and the following report, drawn up by Mr. Arthur Thomson, the Assistant Superintendent of the Society's Gardens, was read:—

Report on the Insect-house for 1901.

The following is a list of the Lepidopterous Insects exhibited in 1901:—

Silk-producing Bombyces and their Allies.

Asiatic.

Attacus atlas.
—— *cynthia.*
—— *ricini.*
Rhodia fugax.
Antherœa mylitta.
—— *yama-mai.*
Caligula japonica.
—— *simla.*

American.

Samia cecropia.
—— *gloveri.*
—— *ceanothi.*
—— *euryalus.*
Attacus orizaba
Actias luna.
Telea polyphemus.
—— *promethea.*
Hypochera io.
Dirphia tarquinia
Eacles imperialis.

African.

Nudaurelia cytherea.	**Nudaurelia wahlbergi.*
*—— *zambesina.*	*Gonomita postica.*
—— *tyrrhea.*	

Diurnal Lepidoptera.

European.

Papilio machaon.	**Limenitis camilla.*
—— *podalirius.*	*Charaxes jasius.*
Thais polyxena.	*Vanessa antiopa.*

American.

Papilio asterias.	*Papilio zolaicon.*
—— *ajax.*	*Limenitis disippus.*
—— *cresphontes.*	—— *ursula.*
—— *troilus.*	

Nocturnal Lepidoptera.

Acherontia atropos.	*Deilephila euphorbiæ.*
Smerinthus ocellatus.	*Chærocampa alecto.*
—— *tiliæ.*	—— *elpenor.*
Sphinx ligustri.	*Ceratomia amyntor.*
—— *pinastri.*	

* New to Collection.

Of the Lepidopterous insects which I have the honour to place before the meeting, the specimens of *Nudaurelia zambesina*, *N. wahlbergi*, and of a South African *Cossus*, presented by Mr. W. L. Sclater, are exhibited for the first time. The specimens of *Nudaurelia* were received from near Pretoria. For the other specimens of African Bombyces (which have been exhibited before under the generic name of *Antheræa*) the Society are indebted to Messrs. W. L. Sclater, F.Z.S., H. W. Bell Marley, and Majors Young & Clarke. For the cocoons of *Dirphia tarquinia* the Society are indebted to Dr. A. E. Goeldi, C.M.Z.S., Pará.

Mr. R. E. Holding exhibited and made remarks upon the skull of a "Hummel," or Hornless Stag, shot at Glen Tana, and the skull of a Stag in which the left horn had been absent from birth; also the skull of a Welsh Sheep having four horns, a rare occurrence in this breed; besides several specimens of horns of Cattle showing bifurcation of the core-nodules in the horns and other peculiarities.

Mr. R. Trimen, F.R.S., communicated a paper by Lieut.-Col. J. M. Fawcett, entitled "Notes on the Transformations of some South-African Lepidoptera." This memoir was in continuation of one by the same author, already published in the Society's

'Transactions' (vol. xv. p. 291). It illustrated the earlier stages of 32 species, of which 6 belonged to the Rhopalocera and 26 to the Heterocera. As in the previous memoir, the *Sphingidæ* and the several families of the Bombyces predominated in the series illustrated, and many of these were of special interest in connection with what was known of the earlier stages of the same groups of allied species in the Oriental Region.

This Memoir will be printed entire in the Society's 'Transactions.'

The following papers were read:—

1. The Evolution of Horns and Antlers. By Hans Gadow, M.A., Ph.D., F.R.S., F.Z.S.

[Received March 18, 1902.]

(Text-figure 25.)

There are three works to which we naturally turn for information concerning mammalian structures: Flower and Lydekker's 'Study of the Mammalia,' Bronn's 'Thierreich,' Mammalia by Giebel, continued by Leche, and Gegenbaur's 'Vergleichende Anatomie der Wirbelthiere.' But the treatment of the morphology and phylogeny of the Ruminants' horns and antlers in all of them is singularly deficient and inadequate.

The actual development of Horns and Antlers has been studied often enough, but no subsequent writer has taken the trouble of sifting and reconciling the various contradictory statements. Sandifort, in 1829, stated that the bone-core of the Bovine horn is a compound structure, composed of a frontal outgrowth or pedicle, and a superimposed ossification in a cartilaginous matrix—the os cornu, which soon becomes indistinguishably connected with the pedicle by synostosis, so much indeed that the frontal sinuses in time extend not only into the pedicle, but also into this os cornu. Lieberkühn found cartilage in the budding prickets of the Roebuck. Cartilaginous preformation, with subsequent metaplastic ossification, was advocated also by Joh. Müller, Gegenbaur, Kassowitz, and others. Landois declared the development and ossification of the antlers as entirely periosteal. Julius Wolff and Robin et Herrmann deny the existence of cartilage, and call the ground-substance of the budding antler amorphous embryonal tissue, or "substance pré-osseuse."

Rütimeyer, most careful observer and far-seeing thinker, naturally homologized the os cornu of the Bovidæ with the deciduous antler of the Cervidæ; but the os cornu seems to have fallen into oblivion until A. Brandt, as late as 1892, rediscovered, or, rather, reinstated it. Brandt gives the following synoptic table of "Haut- und Knochen Hoerner" (*i. e.* epidermal and bony

"Horns"), an arrangement which we find adopted by Leche (*op. cit.* p. 980):—

Os cornu absent	Integument unaltered	the unpaired boss of the Giraffe.
Os cornu present	Integument unaltered, os cornu persisting .	paired horns of Giraffe.
	Integument thin, short-haired, os cornu cadue[1]	Antler sensu strictiori—Subuli.
	Integument cornified	horn-sheath shed—Antilocapra.
		„ persisting—Bovidæ.

Leaving aside the erroneous statement that the median "horn" of the Giraffe possesses no separate bone-core or os cornu, but only a frontal boss, this arrangement looks much better than what it is intended to convey. In fact it represents exactly the phyletic stages which I shall endeavour to prove as correct. But Brandt says explicitly that the antler represents a higher, physiologically more complicated, differentiated stage of the bovine armament. In this respect he agrees with Rütimeyer, who considered the Cervidæ as the "unfertigste und neueste" of all Ruminants. Moreover, Brandt suggests the following evolutionary stages: First, epidermal horns (analogous to those of Rhinoceros); secondly, the acquisition of frontal pedicles; thirdly, an os cornu and an antler. Lastly, the same author doubts the correctness of Rütimeyer's reasonable view that the Antilocaprine armaments are intermediate between those of Bovinæ and Cervinæ.

Gegenbaur (1898), ignoring the os cornu altogether (*op. cit.* p. 106-107), misses the proper connexion which exists between horns and antlers. His remarks are not so precise and lucid as they might be, and there is not a word about the most suggestive preformation in a partly cartilaginous matrix.

Nitsche (1898) has tried to give a coherent account of the whole question, but he does not seem to have made any other than macroscopic examinations. Starting with well-ascertained instances, observed in the Stag and Roe, where lesion of the side of an otherwise normal pedicle has caused the growth of extra antlers, he concludes that these cannot be anything but outgrowths or exostoses of the frontal bone. Consequently, he argues, such extra antlers cannot be homologous with normal antlers if such are dermal bones; *i. e.*, according to his unfortunate definition, bones which are developed within the skin alone and without connexion with the skeleton. He then refers to the mode of growth of the first knobs and prickets of the young Roe, that there is no difference in structure and development between pedicle and pricket, anyhow that both are one and the same *apophysis*, while the separate existence of the os cornu in the Bovidæ shows that their bone-core is an *epi*physis. He then logically opposes the two organs to each other. Moreover, he looks upon the armaments of the Giraffe as exquisite types of cutis-ossification, in fact, as examples of free dermal bones, since they develop

[1] Obviously a misprint of Brandt and Leche for caducum.

loosely in the skin, and even shift their position across the fronto-parietal suture, and fuse very late with the cranial bones. He naturally combats Rütimeyer's comparison of the antlers with the Giraffe's "horns," which he seems to look upon as *sui generis*.

Not a few writers, amongst them Nitsche and Rœrig, are not clear about the meaning of the somewhat unfortunate terms "Hautknochen," dermal or membrane-bones. Rœrig, for instance, thinks that thereby are meant epidermal organs. In reality they are contrasted with cartilage-bones as membrane-bones. To call the latter promiscuously dermal bones has caused endless confusion. A necessary condition for ossification is the presence of an amorphous ground-substance or matrix, which is then converted into, or rather supplanted by, bony tissue. Ossification is consequently always a secondary process. Unless the ground-substance is preformed as amorphous embryonic tissue, it has first to be produced out of existing adult cartilage or other connective tissue by the action of the osteoclasts or similar katabolic, histioclastic cells, which by their breaking-down action upon the tissue dissolve the latter into a medium in which osteoblasts can live, multiply, and by excreting or attracting and arranging around themselves certain salts, turn into bone-corpuscles. On the surface of regenerating bone the marrow-cells, giant-cells, myeloplaxes, seem to produce this ground-substance. In the case of cartilage this is first destroyed, one might as well say dissolved, by the cells which immigrate through the perichondrium, a process which happens frequently when membrane-bone comes into contact with cartilage. It was a great step forwards when it became understood that the place of origin of all bone-forming cells was to be referred to the so-called basal membrane of the epidermis, whence osteoblasts infiltrated or invaded the corium or mesodermal portion of the skin. Recent observations warrant us to go a step further, and to assume that the original home of all skleroblasts was in the Malpighian layer of the epiderm itself. The oldest immigration of skleroblasts from the ectoderm into cutis and other mesodermal tissue has formed cartilage; the next immigration of skleroblasts has given rise to bone. The latter being superior, supersedes the cartilaginous skeleton. The ectoderm has by no means lost the capacity of producing either kind of skleroblasts. Extraordinary excitement and requirements, reactions upon external stimulus, produce this rejuvenescence, even in the mammalian skin.

Exquisite examples of true dermal bones are those ossifications "within the skin" which in Amphibia and Reptiles are now generally called osteoderms. They occur also, among Mammalia, in the Armadillos, but in no other group of this class, unless it were in the Cetacea, where Kukenthal has found traces of a dermal armour. In the Amphibian *Ceratophrys ornata* the "dorsal shield," although very thick itself, has sunk in so deeply that it is now in contact with the vertebral processes and is covered by the ordinary, movable skin. In *Pelobates* the skin of the upper surface of the head is partly co-ossified with the underlying cranial bones, giving them a pitted appearance. Now. frontal and parietal being membrane-bones, or at least membranes which have received their bone from the cutis, this superimposed ossifying mass of *Pelobates* is a second instalment, or second generation of dermal bone. Similar successive repetitions of the same process are demonstrated in those Amphibian and Reptilian vomers which carry teeth, the vomers themselves having resulted from the fusion of the basal portions of teeth which themselves are now lost.—Concerning the cranial membrane-bones, there is no doubt that the original cartilaginous roof has vanished (it is restricted to the dura mater), not because its cartilage has been destroyed, or supplanted, by immigrating bony tissue, but because it has been gradually suppressed by the approaching, investing, membrane-bone. Similar instances of suppression, not conversion, are the greater portion of Meckel's cartilage, the premaxillæ and maxillæ, probably the palatine and quadrato-jugal bones of Birds and Mammals, and to a great extent the mammalian quadrate through its conversion into the os tympanicum. On the other hand, the human clavicle surrounds, and is intermixed with, the precoracoidal cartilage.

The next points of importance considered by Nitsche are the composition and shedding of the horny sheaths of *Antilocapra*, which he does not homologize completely with the bovine horn-sheaths. He prefers putting the Prongbuck's horns into a position intermediate between the velvet of the Giraffe and the horn of the Bovidæ. The following is his terse summary:—The

integument of the Giraffe is only hairy, that of the Prongbuck is hairy and horny, that of the Bovidæ only horny. Having satisfied himself about the apophysial nature of the antlers in opposition to the epiphysial condition of the bony core of the Giraffe and Bovidæ, he naturally feels justified about the complete removal of the Giraffe from the Cervidæ and the fundamental difference between bovine and cervine ruminants.

These conclusions are not satisfactory. *First*, it is not likely that several fundamentally different kinds of armaments should have been developed within such a circumscribed and specialized group as the higher Ruminants or Pecora. It is of greater scientific value if we can trace all these armaments not only to the same beginning, but bring them all into one evolutionary line, so that these organs afford a clue to the phyletic development of the various groups of Ruminants. The ultimate cause of these armaments must have been the same, namely butting with the head, causing irritation, which in turn leads to hypertrophy of the cranial bones, together with the covering periost, cutis, and epidermis[1].

Secondly, the origin of the os cornu, sometimes with a separate centre of ossification, has to be accounted for, since it is quite impermissible to assume that it was a preformed bone in the skin, which has later become fused onto the skull. Nor is there a single instance in mammalian pathology of loose ossification in the cutis due to repeated pressure or irritation, conditions which, on the contrary and invariably, lead to exostosis of the underlying already existing bone.

Thirdly, there is the palæontological evidence, not very plentiful, but one fossil in hand is worth more as a proof of phyletic speculation than ever so many ontogenetic observations. Curiously enough, few palæontologists, whilst throwing much light upon the evolution of the cervine antlers, have tried to take a broad view of the phyletic side of the whole question, and the comparative anatomists have, as usual, left the fossils severely alone.

Lastly, there is the Giraffe and its relation, the Okapi, the former with multiple, early appearing protuberances in both sexes, the other apparently with none.

The question at issue requires a renewed investigation of the development of the cervine and bovine armaments and a sifting of the palæontological evidence.

I. *Development of the Cervine Antlers.*

The first growth of a buck's antler in his first year is already a compound structure. It begins with a bulged out elevation or knob

[1] The general considerations and conditions have been well described and argued out by J. J. Cunningham, 'Sexual Dimorphism,' pp. 73–104. The evolution of horns and antlers, studied with due regard to the interesting physiological features, is one of the clearest demonstrations of the acquisition and inheritance of new organs, whilst any attempt to account for them (not their shape!) by variation and selection alone would be ridiculous.

of the upper lamina of the frontal bone, which forms the *pedicle*. This is a direct continuation of the frontal, identical with it in its dense, lamellar structure, numerous Haversian canals and its blood-supply, and it is covered by the same unaltered skin. It is, in fact, an exostosis or apophysial growth. On the apex of this pedicle the skin and the periost are thickened. The skin is devoid of sudoriferous glands, produces no stiff, but only very fine and soft, velvety hairs, is like them darkly pigmented and of a glabrous appearance. The cutis is in direct, intimate continuation with the periost, and contains numerous, but small vessels, chiefly lymphatic, and only capillaries perforate the periost.

Immediately beneath it follows a dense layer of hyaline cartilage, which, together with rapidly proliferating connective tissue, makes up the apical portion of the pedicle and forms the growing point of the future pricket. Vertical sections through the growing pricket and pedicle show that the cartilage pervades the top portion in the shape of strands, trabeculæ, and walls, which partition off equally proliferating masses of ingrowing connective tissue in which turn up bone-forming cells. The bulk of this ingrowing tissue comes in with the vessels which extend from the interior of the pedicle upwards into the base of the soft mass on the top; little connective tissue enters together with the small vessels of the periost. The process of ossification begins at the base and near the periost, pervading the whole growth in the shape of a very irregular framework, without forming concentric bone-lamellæ and with but few Haversian canals.

The first prickets or broaches are short-lived; they are shed in the middle, or even earlier, of the first winter. The shedding of a full-grown antler has always rightly been referred to necrosis, but it is a rather complicated process. To begin with, the antler continues to ripen, or to harden, by the deposition of bone in the more spongy, axial centre, long after the velvet has been frayed off, the loss of which is consequently not the only, nor the main cause of the decay of the antler. The latter is nourished not only by the big vessels (branches of the temporal artery) which, ascending in the skin and periost, cause the "gutters," but also by the numerous vessels which ascend through the pedicle into the interior of the antler. The base of the latter, where it passes into the pedicle, becomes much denser and harder, instead of remaining somewhat spongy in the core, and the blood-supply is stopped. About the same time, at a level *below* this junction, *i. e.* within the top portion of the pedicle itself, the Haversian canals are widened owing to activity of osteoclasts, and they become confluent into a "resorption-sinus." This is met by a ring-shaped furrow, which eats its way from the periost inwards. The hardened base of the antler is slightly convex, while the resorption-sinus forms a somewhat deeper cup on the top of the pedicle. Owing to this mode of resorption, which always affects the pedicle, this becomes lower every year, but it makes up for this loss by broadening. Long pedicles are consequently the older

stage, both onto- and phylogenetically. The cup is filled with lymph, some oozing-out blood-clots and a rapidly increasing mass of proliferating cells which are granulating from the walls of the cup. This mass is soon, within a day or two, covered over by a thin network of epidermal and connective tissue proceeding concentrically from the edges of the skin, which arises in the shape of a thickened ring-wall. Large vessels, branches of the temporal artery and facial vein, accompanied by branches of the facial and trigeminal nerves, ascend in the much-thickened cutis which covers the whole growth. These big vessels send only very fine branches into the antler, and they soon become capillary. These seem to anastomose with the terminal capillaries of the vessels which ascend within the antler. Owing to this arrangement, the outer portions of the antler receive more calcareous salts than the inner parts. They are denser, more opaque, and harder. Ossification of the whole soft and spongy mass proceeds from the base and periphery upwards.

It is important to note that the preparatory process of shedding follows immediately upon the time of greatest exhaustion, *i. e.* after the rutting-season, and that the beginning of the new growth does not coincide with the awakening of sexual activity. Herewith harmonizes the fact that adult stags, when castrated, shed their antlers within a few weeks, whereupon a new growth is formed, which, however, continues to grow throughout life, resulting in abnormal, more or less monstrous antlers.

It is assumed generally that the fraying of the velvet has originated through fighting, that the bared portion of the antler-bone became necrotic, and had therefore to be renewed &c., and that the whole process of stripping, necrotising, shedding, and renewing has become rhythmical—a feature due to cumulative inheritance. This may be the case. But there is another consideration. There would be no reason why antlers and velvet should not grow continually, and mend or rebuild injured or lost portions like other parts of the body, unless there occurs a diversion or stopping of the energy and supply of building-up material. Such a diversion is actually caused by the awakening of the sexual glands. They are the important organs, and all the energy and supply (which after all have their limit) not necessary for the keeping up of the body and life of the animal are concentrated upon the generative system, while nothing can be spared for the further growth of secondary exuberances. Therefore the blood-pressure in the head is diminished, the supply of the skin covering the antler gradually ceases, and the velvet itself becomes necrotic, from the apex downwards.

II. *Development of the Bovine "Horns."*

The bovine or antelopine "horn" is, as a rule, described as consisting of a bony core, itself an outgrowth of the frontal bone, and the horny sheath. In reality it corresponds exactly in growth

and composition with the pedicle and antler of the *Cervinæ*. The homologue of the antler has, since Sandifort, been called the *os cornu*, and it forms by far the greater mass of the whole bony cone. It has already been stated that it is continuous with the pedicle, so much so that in many species of Cavicornia, especially of Oxen, the sinuses of the diploë extend far into the cone, in old animals far towards the apex. Occasionally the os cornu ossifies from a special centre, separate from the frontal bone. It is, however, short-lived as a separate entity. A. Brandt found it in lambs as a small bony nodule, which could be lifted out of a corresponding cup-shaped depression of the frontal bone in very young animals. It fuses with the rest when the lamb's horns are perhaps 3 cm. long. Nitsche found it in the kid of a Chamois whose horn-sheath was only 2 cm. long, and he adds that it is already firmly fused with the frontal bone in the first autumn. I myself have several times come across specimens of ewe-skulls which had been bleaching for a long time on the Welsh hills, and in which the upper lamina of the frontal bone had fallen off at the precise spot which normally carries the horns. There is no pedicle in these specimens, but this absence is due to the feebly developed state of the horns of these ewes, which as a rule do not carry such organs. In calves, even the youngest, a separate os cornu is unknown, but they occur sometimes, pathologically, in polled or hornless cattle as ever-growing bone loosely attached to the head by the surrounding skin. It is a great mistake to imagine that the occasional separate ossification of the os cornu is a primitive feature.

The normal development of the calf's head-gear is as follows:—Slight elevation of the frontal bone into a comparatively broad-based but low pedicle. This is surmounted by a shallow cone composed of fibrous connective-tissue and cartilage. The cartilage has its growing-point near the apex. The perisclerium is continuous with the periost of the pedicle portion. Ossification proceeds from the pedicle upwards, transforming the soft growth into a bony cone, the cartilage being gradually restricted to the apex. The last traces of cartilage vanish when the horns are between one and two inches in length, and the os cornu then continues to grow by the ordinary subperiosteal mode, young connective-tissue continuing to proliferate especially at the apex. Blood-vessels enter from the pedicle and from the periosteum. The periosteum passes imperceptibly into the rest of the cutis. Vertical sections of a young "horn" half an inch in length show all the minutest features in diagrammatic clearness. The specimens were decalcified in picric and nitric acid, then cut and stained with the triple stain of Erlich-Biondi, with hæmatoxylin and picric acid, or with thyanine.

Outside is the dense mantle of horn passing towards the Malpighian layer into the characteristic comb-shaped jagged processes in the act of transformation into horn, each of the processes resting upon a finger-shaped extension of a cutis-papilla.

Below and between them are numerous hairs, some of which reach the surface and are imbedded in the horny mass, others are hemmed in and suppressed.

The rest is best explained by a diagram. The important point is that the cartilage, dense and hyaline, and in active proliferation near the periost, changes further inwards into clusters of cells which show the same features and the same thyanine-staining action as the so-called muco-cartilage. Towards the strands of young connective-tissue, which becomes more prominent as we proceed inwards, the muco-cartilage cells show a breaking up of their nuclei, so that only a glassy mass remains, interspersed with débris of the cells and their nuclei. [When not decalcified, this mass is somewhat opaque and bluish owing to infiltration with calcareous salts. All this hyaline ground-substance is destroyed by giant cells which are active on the margin and a little further down. The place of the vanishing cartilage is taken up by the network of connective-tissue strands, and in this appear very active marrow-cells, and osteoblasts which build up trabeculæ of bone. Consequently the cartilage is not wanted at all for the construction of the cone. This is also obvious from the fact, mentioned above, that a few months after birth the cone continues to grow long after the last trace of cartilage has vanished. The cartilage is in fact an invader of dormant scleroblast-cells in the periost, different from osteoblasts.] Concerning the horny sheath, I have to mention two important points which have hitherto escaped notice. First, the inclusion and gradual suppression of hairs by the proliferating intercrinal horn-substance. Even in old specimens of cattle-horns hairs become imbedded in the horn-sheath, which in opposition to the bone-core always exhibits basal growth. Secondly, the fact that calves, when several months old, shed the first juvenile hornshoe. This is not always cast off in one piece; it may be frayed off, but this is a process very different from the incessant wear and tear of the permanent horn-sheath of the adult. The shed portion so to speak, the first generation of the horn, is more porous, less solid than the permanent horn, from the base of which it becomes separated to the extent of several centimetres, as shown in the illustration (text-fig. 25, p. 216). The whole process recalls the relation of the neossoptile to the teleoptile or permanent feather, and still more the shedding of our own fœtal finger-nails.

III. *Antilocapra.*

Not much more is known about the development of the Prong-buck's horns than what Forbes and, recently, Nitsche have described. Nitsche has shown that the sheath is an aggregation of sparse hairs connected by much "intercrinal" horn-substance, the whole process resembling somewhat the pathological ichthyosis of calves. He has also shown that the prong is formed entirely by the horn-sheath, and that there is no corresponding outgrowth

on the bone-core. Forbes remarked that in his specimen "the prong is not yet visible, but may be felt at the base of the pedicel, close to the skull, on the anterior margin of the horn." (*Cf.* text-fig. 25, III[2].) In well-macerated specimens in the Cambridge Museum, the difference between the rather long pedicle and the decidedly short os cornu proper is well marked. Owing to the continued and active growth of the shoe from the base, the axial point and the prong are gradually pushed upwards, so that the prong comes to lie far above the skull in a level even above the base of the os cornu, which in the adult is thinned out into a non-osseous, tapering, string-like cone of soft connective-tissue and periost. The shoe continues to grow basally, and ultimately engulfs not only the os cornu but also nearly the whole pedicle.

IV. *The Giraffe and the Okapi.*

It is of no importance to the present investigation whether the few hitherto known skulls of the Okapi are those of young or adult males or females. The skulls exhibit the same tendency towards broad-based swellings on the fronto-parietal and facial regions as in the Giraffe. Even in the latter genus these parts, although slight and bulging, owing to the pneumatic condition of the bones of such a weakly constructed skull, can ill be reconciled with the only reasonable explanation of the genesis of horns and antlers. We have to assume that the ancestors of the Giraffe had stronger skulls, with serviceable antlers, and that these armaments have caused the bosses of the supporting bones, and that in the Giraffe these very armaments have degenerated into now merely ornamental remnants, vanished in the Okapi. It is possible, as Mr Thomas has sagaciously suggested, that the degeneration of these armaments is correlated with the lengthening of the fore-limbs and neck, the animals ceasing to fight with their heads and using the powerful fore-limbs instead. This applies obviously to the Giraffe, but not so easily to the Okapi, unless we look upon the latter as the most degraded descendant of the whole group, which, although perhaps never numerous, was certainly more widely distributed in the shape of several genera and species. At any rate, the Okapi represents not the beginning, but the most modern and most modest member of a tribe which has flourished in bygone times.

There are other proofs that the Giraffe's armaments represent no primitive condition. The bony growths appear loosely in the skin, a condition which finds a parallel in the cases of separate ossification of the os cornu of certain *Bovinæ*. Their matrix has become so emancipated from the skull, that they shift their position before fusing onto the cranium, and their mode of fusion is most peculiar. As Mr. Thomas has expressed it graphically, not only at the base of the growth, but around it, and quite irregularly, there appear little bony nodules, which become amalgamated with the cranium as if wax had been dropped upon it. Such numerous, small and irregularly scattered "osteoderms"

are not primitive, they are the expression of degeneration, of the breaking up of a once powerfully developed bony growth.

Fossil Giraffe-skulls are unfortunately still unknown, but *Samotherium* with frontal and posterior protuberances, *Sivatherium* with posterior growths hollow at the base and with frontal growths, lastly *Brahmatherium* with posterior and frontal armaments, are undoubtedly allied to the Giraffoid stock. We leave out the unarmed *Hydaspitherium* and *Helladotherium*, which are suspected by experts to be female *Sivatheria*. It has been questioned whether these armaments, huge, and sometimes branched, were covered with skin and hair, or with horny sheaths. The antlers of the original specimen of the male *Sivatherium* clearly show deep and strong impressions of the blood-vessels, extending almost to the tips exactly as in Cervine antlers. They were undoubtedly covered with skin, and it would be hardly fair to assume that this and similar specimens happened to have died in the velvet stage. The same applies to *Samotherium boissieri*. But it does not follow that these armaments were true antlers in the sense that they were shed. Dr. Forsyth Major is inclined to think that there are sutures between them and their base. If there are any, they simply indicate the line of transition or demarcation which is usually seen between the pedicle and the rest. The hindmost pair of armaments of *Sivatherium* are hollow at the base, a fact which speaks decidedly against periodical shedding; and the broadness of the base supports this view, since a good and permanent vascular supply from below was thereby ensured. The much shortened shape of the skulls of *Sivatherium* and *Brahmatherium* are unmistakable signs of specialization, excluding the possibility that these huge creatures of the latest Miocene or lowest Pliocene were the direct ancestors of Giraffes; but they were near relations and contemporaries.

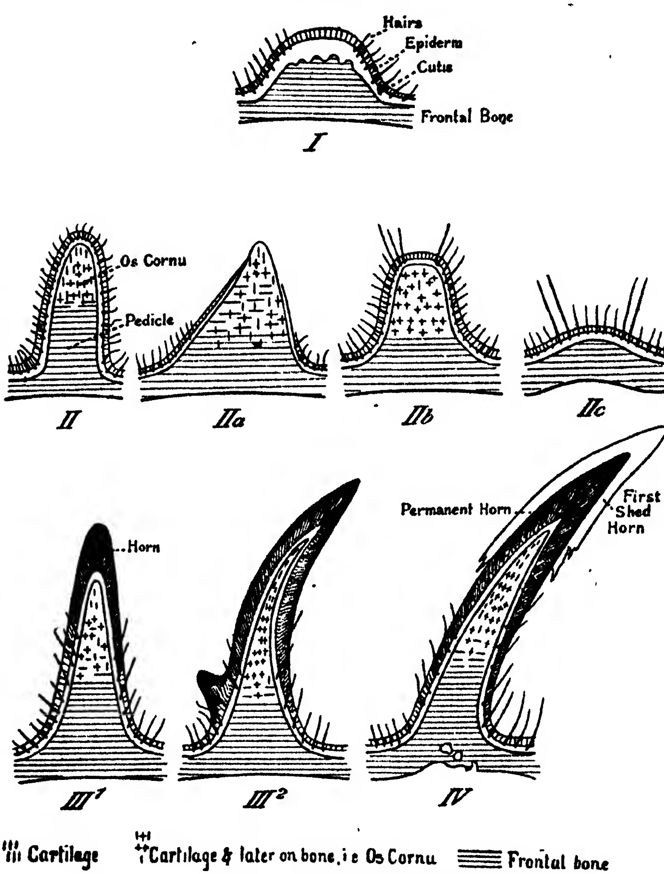
We are now able to conclude that the evolution of Horns and Antlers and similar cranial armaments has passed through the following stages:—

I. Exostosis. Subperiosteal ostotic outgrowths of the cranial bones, covered presumably with thickened skin-pads. These armaments were multiple, occurring on various parts of the skull. This type is rather old among the Ungulata, witness the Eocene Amblypoda, e. g. *Dinoceras*. It reoccurs amongst the Artiodactyla, which here alone concern us. *Protoceras* of the Lower Miocene of Montana is an almost ideal type in this respect, with its three or four pairs of facial, orbital, and posterior bony excrescences in the shape of uncouth ridges and neat cones. (Text-fig. 25, I, p. 216)

II. Exostosis of the frontal bone producing a *pedicle*, with epichondrosis of apical growth, which by subsequent basal ossification becomes the antler. Skin originally unaltered, hairy; this and the chondrosteoma are shed periodically.—*Cervine type*. (Text-fig. 25, II, p. 216)

These stages are repeated by every young Cervine male. A portion of the integument is frayed off, at first perhaps accidentally, then repeatedly during the annual rutting-time, and a

Text-fig. 25.



Evolution of Horns and Antlers.

I. *Protoceras.*	III¹. *Antilocapra*, adult; early stage.
II. Young Stag, with velvet.	III². „ „ ; later stage, when the prong begins to grow.
II *a*. *Sivatherium.*	IV. Domestic Calf.
II *b*. Giraffe.	
II *c*. Okapi.	

rhythm of regeneration is established. The regeneration naturally concerns chiefly the additional chondro-osseous apical portion, this being the distal and therefore more easily injured part. But

originally, as still shown by the mode of growth of the youngest stage, no hard-and-fast line can be drawn between antler and pedicle, and even now in recent species part of the *bona fide* pedicle itself (*i. e.*, that part which is not infiltrated with cartilage) is annually destroyed and regenerated, although not "shed."

It is safe to presume that the earliest *Cervinæ* had long pedicles and short antlers, or rather prickets and broaches. The further development into long and branched antlers is an instance of the morphologically and pathologically well-known fact that organs which are originally due to hypertrophic causes are liable to grow to excess. There is no maximum limit to the size of antlers and to the number of tines in the Stag, although old individuals are liable to "decline."

The earliest typically Cervine creatures are referred to the genus *Palæomeryx*. The somewhat mixed synonymy of genera and species has to a great extent been unravelled by Roerig, who has described and figured every known specimen. Finality is, however, impossible until we know for certain whether the separately found pedicles and antlers, or both together, are successive stages of one species, or represent the armaments of several adult species, or genera, which did not pass beyond the respective stages of broachers, forkers, &c.

Two frontal pedicles and two pedicles with simple, low, spiked antler-fragments are known from the Lower Miocene of Hessler. They show already a slight burr, proof that the tips were shed. Roerig, assuming that these fragments and the following specimens form the successive stages or "heads" of one and the same species, refers them to *Dicrocerus furcatus*.

The second stage, or "head," is represented by typical broaches, with a distinct little burr, from the *Dinotherium*-sands. They are referred by Roerig to *D. furcatus*, second stage or head, equivalent to *D. elegans* of Lartet = *D. dicranocerus* of Kaup.

The third stage, or head, with a thick, somewhat compressed antler ending in a short fork, is *D. furcatus* from Steinheim, Mid-Miocene. Another specimen, from the same locality, has a deeper fork and a thicker burr--*D. furcatus*, fourth head. The burr, not sharply marked off, but rather a thick swelling, bears a striking resemblance to a specimen of an immature *Antilocapra* in the Cambridge Museum. The bony fork of course excludes any further resemblance and affinity.

The last stage, with a gracefully forked long antler, with typical burr upon the still long pedicle, is represented by *D. elegans* from Sansan, Mid-Miocene; it is possibly the final head of *D. furcatus*: synonymous with *Procervulus* Gaudry, *Micromeryx* Lartet? The Neotropical *Subulo* s. *Coassus* e. g. *C. rufus* still remains in the broacher stage; and *Cervulus*, the Muntjac, is an incipient forker. *Hydropotes inermis* alone, of China, has no outgrowth whatever.

The possession of deciduous, large, many-branched antlers amounts to an enormous waste of energy and material during the

life of the owner. Although full of grace and beauty, antlers are morphologically very faulty structures, as wastefully contrived as the shedding of the thousands of teeth of Sharks and Crocodiles. The long duration of the growth of the antlers, their soft and highly sensitive condition during this time, is even a distinct trouble, not to say danger, a circumstance which shows clearly that these organs are not primarily weapons to be used against other species.

II *a*. A side issue from II. Epichondrotic growths preponderant, with multiple and broadened bases. Ossification delayed but still proceeding from base. Cranial exostoses or pedicles correspondingly reduced. These weapons with an increasing tendency of intraperiosteal growth reached a large size in width and length, and remained permanent structures. The tips of the orbital and posterior pair of weapons may have been covered with thickening epiderm, more or less hairy; the bulk of the growth was permanently covered with the unaltered hairy skin. It is possible that this protecting cover and the tips of the bony core were worn off without impairing the fighting use of these massive structures, which need not die off thanks to the remaining velvet, or (even if this was ultimately lost) thanks to the unimpaired vascular supply from the interior of the broadened base. Creatures thus armed reached their culmination in the huge *Sivatherium* and *Brahmatherium*. (Text-fig. 25, II *a*, p. 216.)

Here we have to confess the existence of a painful gap and a vagueness in connecting this type II *a* with others of the main line. This difficulty will remain until fossil ancestors of these creatures are found. That they form a side issue is obvious enough. So far as the few actually known genera are concerned, they are of the latest Miocene, perhaps of the lowest Pliocene date, anyhow considerably younger than *bona fide* Cervinæ which we can trace back into Lower Miocene. In this respect, and by the morphological agreement between the stalked posterior antlers of *Brahmatherium* with pedicle and antler of an early Stag, we are justified in looking upon this type II *a* as a side-branch of the main type II. On the other hand, the prevalence of multiple outgrowth, facial, orbital, parietal, and generically variable, might rightly be urged as a primitive feature, resembling in this respect type I, so that the *Sivatherium* type would form a side issue somewhere between I and II. However, it must be borne in mind that multiple pairs of such weapons crop up pathologically in recent Cervidæ, and normally even in the Antilopine *Tetraceras*—facts which nobody can possibly consider as primary. Consequently the multiple armaments of the Progiraffine creatures are not absolutely an indication of their great phyletic age and low position.

II *b*. Terminal, further development of type II *a*. Epichondrotic growths proliferating freely and with broad bases, so that they form intraperiosteal growths, separated from the cranial bones, and consequently ossifying independently of them, ultimately fusing with them. Cranial apophyses or exostoses, or pedicles, much reduced in height. Disuse of the outgrowths, implying cessation of the irritation upon the basal periost (*i.e.* between the growth and the cranial bone), explains diminution of the pedicles and their late fusion and the long delayed process of ossification. But the development of the ecchondrotic mass, inherited from the ancestral stock, and subsequent ossification still go on, although without a purpose, and they produce organs which, owing to their late fusion with the cranium, their original home, now appear as osteoderms, although in reality they are pseudo-primitive organs. The integument remains hairy, except on the top where the epiderm proliferates and cornifies a little. Example, the *Giraffe*. (Text-fig. 25, II *b*.)

II *c*. Apparent loss of all these armaments, the last remnants being frontal bosses: *Okapi*. (Text-fig. 25, II *c*, p. 216.)

It is worth noting that, while the females of *Sivatherium* and *Samotherium* are, by general consent, not credited with "antlers," the Giraffe makes an exception in this respect. This fits in with the view, expressed in this paper, that Giraffes represent a terminus of one line of development. There are some typical *Cervinæ* of which both sexes are antlered. The acquisition of secondary sexual organs by the females is mainly a question of time. It is an illustration of simple, direct inheritance from the other sex, so common in organs which are connected with sexual activity, *e.g.* clitoris, mammæ, spurs. These things are of not the slightest good to their new possessors, but they do no harm either. They are therefore neglected, rather not discovered, by natural selection.

III. The same initial stage as type II. A long pedicle with a simple broach, covered with hairy skin, but the epidermal portion of this tegumentary sheath proliferates, glues the hairs together and embeds them. The horny sheath is an efficient protection against injury; the external or cutaneous and the internal vascular supply remain, and the simple antler is shed no longer. Immature specimens still show a thickened, burr-like swelling at the juncture of the pedicle and antler. We assume that the horn-sheath consisted originally of an imperfectly welded material still liable to fraying, until it became effective enough to prevent any necrosis and subsequent shedding of the antler, which thereby becomes an os cornu. So long as the hair preponderates in the deeper strata, the shedding and

renewal of the hairy coat is likewise repeated by the horny sheath. This stage is still represented by *Antilocapra*, although the horny sheath by continued basal growth gradually envelops also the greater part of the pedicle. (Text-fig. 25, III, p. 216.)

IV. Direct continuation of types II and III, still repeated stage by stage ontogenetically. An improvement towards the preponderance of the intercrinal horn-substance, the conversion of the sheath into a morphologically well-finished horn-sheath, the suppression of the hairs, and of periodical shedding of any part of the whole compound weapon, was only a question of time with onward evolution, This, the highest and most perfect stage, is represented by the typical *Antelopine* or *Bovine* Ruminants, of which their peculiar member, the Prongbuck, still falls short. They are morphologically the highest, palæontologically the latest of Ruminants. Herewith it agrees that horns are carried by both sexes, whilst the inheritance of these organs by the females is still a rare exception amongst the *Cervinæ*. Moreover, these weapons, having become permanent and evergrowing, and therefore useful throughout the year, are of much greater value to their bearers. (Text-fig. 25, IV, p. 216.)

Attention has already been drawn in this paper to the important fact that the horns of a young calf still contain a considerable number of hairs mixed up in the sheath, and that in older animals such hairs are restricted to the more basal portions; secondly, that the top cone of the hornshoe is shed. In Ewes this first generation falls off as a thin, transparent cap of the size and shape of half a hazel-nut. In fact this first cap of the Bovine horn is in every respect homologous with the shedding sheath of the Prongbuck. The Oxen, Sheep, and Goats now exhibit only once a process of shedding which in their immediate ancestors must have been of frequent occurrence, and which in the Prongbuck is still a periodical feature.

The types I, II, III, and IV, exemplified by the Eocene *Dinoceras*, the *Cervinæ* since the Lower Miocene, the Prongbuck, still existing, and the hollow-horned Ruminants or *Bovinæ*, are an illustration of onward phyletic evolution; and these stages are still faithfully repeated in the development of the recent species. Ontogeny is a shortened recapitulation of phylogeny.

Titles of the more important Literature referred to in the text.

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ROBIN et HERRMANN. Mémoire sur la Génération et la Régénération de l'os des Cornes caduques et persistentes des Ruminants. Journ. d'Anat. et de Physiol. 1882, pp. 205–265, pl. xix. (Excellent account of the development in the Roebuck.)

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ROERIG, A. Ueber Geweihentwickelung und Geweihbildung. Arch. f. Entwickl. Mechanik, x. (1900), pp. 525–644, pls. xii.-xiii.; xi. (1901), pp. 65–148, pp. 225–309. [Numerous drawings of antlers, both normal and abnormal; with a complete list of the literature and a historical review of the whole subject, but he, as well as Brandt and Nitsche, have restricted themselves practically to macroscopic features.]

Important from a general point of view are also:—

Sir VICTOR BROOKE. On the Classification of the Cervidæ. . . P. Z. S. 1878, pp. 883–928.

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CUNNINGHAM, J. T. Sexual Dimorphism in the Animal Kingdom. London, 1900.

P.S.—On the day this paper was read Dr. Forsyth Major gave me intelligence of a paper by Dr. J. Ulrich Dürst. A copy of his "Versuch einer Entwicklungsgeschichte der Hoerner der Cavicornia nach Untersuchungen am Hausrinde" [Forschungen auf dem Gebiete der Landwirthschaft, Frauenfeld, 1902] reached me on March 24th. The author has also observed the shedding of the first horn-sheath; he likewise correctly states

that the budding growth of the bone-core differs in structure and mode of development from the frontal bone proper, but he emphatically doubts the temporary separate existence of the os cornu, and he feels satisfied that it is not formed by the intervention of cartilage, since the substance in question was not coloured blue by hæmatoxylin staining. He and others will have to accustom themselves to the existence of cartilage in places where text-books carefully abstain from mentioning it.

2. On a new Stridulating-Organ in a Scorpion. By R. I. Pocock, F.Z.S.

[Received February 25, 1902.]

(Text-figure 26.)

Stridulating-organs have been found in three genera of Scorpions, viz., the large species of the Oriental Region and Tropical Africa referred to *Palamnæus* and *Pandinus*, and the South-African members of an allied form *Opisthophthalmus*[1]. In the two first-named the organ lies between the basal segments of the chelæ and of the legs of the first pair; in the latter between the inner surfaces of the mandibles or their upper edge and the front border of the carapace. In all three cases it consists in the main of peculiarly modified bristles. No organ of similar function has as yet been discovered in any other family of Scorpions. But in the Buthoid genus known as *Parabuthus*, which ranges from the shores of the Red Sea to Cape Colony, I find a stridulator (text-fig. 26, A & B, p. 223) differing entirely both in structure and position from that of the Scorpions above mentioned.

It has long been known that the upper sides of the proximal segments of the tail in *Parabuthus* are furnished in the middle with an aggregation of granules, so fine and close-set as to be appropriately comparable to shagreen. The granules are sometimes thickest and coarsest in the median groove, but finer and more scattered at the periphery of the area; sometimes of uniform strength throughout: sometimes they are confined to the median groove; sometimes, and more often, they encroach upon the adjacent area of the surface that bears them.

Of the species known to me, the granulation reaches its highest point of development in *Parabuthus flavidus* Poc., where the granules have run together across the middle line to form short parallel transverse ridges with their free edges directed backwards (text-fig. 26 B).

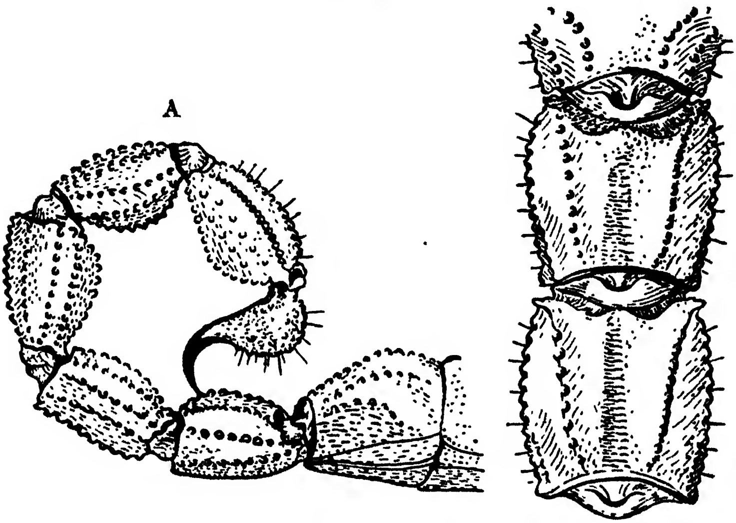
The surface that bears this granulation also differs in formation according to the species. In the more northern and less specialized forms—such as *P. liosoma*, *P. abyssinicus*, *P. hunteri*, *P. granimanus*, and *P. heterurus*—the area in question is but little modified, remaining normally depressed and grooved in the

[1] Pocock, Nat. Science, ix. pp. 17–25 (1896), and Ann. Mag. Nat. Hist. (6) xviii. pp. 75–77 (1896).

middle line; but in many of the southern types—e. g., *P. planimanus*, *P. neglectus*, *P. villosus*—the whole upper surface of the segments tends to become flattened and horizontal both in a longitudinal and transverse direction. A similar granular field is developed between the dorsal keels on the last abdominal tergite.

Text-fig. 26.

A B



Stridulating-organ of *Parabuthus flavidus*.

A. Lateral view of tail, to show the action of the sting during stridulation.

B. Dorsal view of last somite of abdomen and of 1st and 2nd caudal segments, showing the ridges on the median groove of the two segments.

If the tail of one of these Scorpions be brought into the attitude usually assumed by these animals when striking, and the point of the sting be scraped over the granular field, a very distinct sound is emitted, resembling that produced by drawing the point of a needle over fine sand-paper[1].

There is as yet no direct evidence, based on observation of the living animal, to prove beyond dispute that these granules have the function here assigned to them, but the facts which support the conclusion are the following:—

(1) The sound can be artificially produced, and is audible to me at a distance of ten yards or more.

(2) The scorpion itself is capable of performing all the movements necessary for its production.

[1] A similar but less complete development of granules, subserving no doubt the same purpose, is observable in two North-African species of *Buthus*—*B. bicolor* and *B. æneas*.

(3) The granules are especially well-developed upon the first and second caudal segments and upon the last abdominal tergite, against all of which the point of the sting can be forcibly scraped. On the third caudal segment, upon which the sting is capable of but little movement, they are scarcely or not at all developed, and upon the fourth and fifth, which cannot be touched by the point of the sting, they are absent.

(4) The longitudinal flatness of the granular area on the first and second caudal segments, which results from the uprising of the groove and the elevation of the anterior part of the upper surface, can be explained on the supposition that it is designed to give the sting a long and continuous sweep from segment to segment, without the danger of catching against their posterior edges or of wounding the arthrodial membrane. It is difficult to see what other interpretation is to be put upon this special and unique modification of the segments in question.

3. On the Organ of Jacobson in the Elephant-Shrew (*Macroscelides proboscideus*). By R. Broom, M.D., B.Sc.[1]

[Received February 4, 1902.]

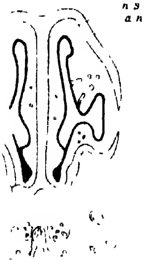
(Plate XXI.[2])

From the examination of the organ[3] of Jacobson in a large series of mammals, I, in 1897, concluded that it varies surprisingly little in even very dissimilar genera of a common Order. In the Marsupialia the chief Polyprotodont genera have their organ of Jacobson very much alike, while even in the Diprotodonts the organs are all formed on a type which differs but little from that found in the Polyprotodonts. While in all the Rodents, so far as examined, the organ is formed on a single peculiar type which seems to be a modification of that found in the Marsupials, in the higher mammals a single type of organ is found in forms so varied as the Hedgehog, Bat, Lemur, Cat, Sheep, and Pig.

It would thus appear that the organ of Jacobson is but little influenced by the habits of the animal, that it remains a clear indicator of the early family relationships of a genus when almost all the other ancestral characters have been so modified as to be scarcely recognizable, and that hence it is of considerable importance in determining the precise affinities of aberrant mammals.

Having recently had occasion to make a series of sections of the snout of a fœtal Elephant-Shrew (*Macroscelides proboscideus*), in connection with a study of the development of the palatine process of the premaxilla, I was naturally much interested in observing the condition of Jacobson's organ, especially as W. K.

[1] Communicated by Prof. G. B. Howes, F.R.S.
[2] For explanation of the Plate, see p. 227.
[3] Trans. R. Soc. Edinb. vol. xxxix. p. 234.



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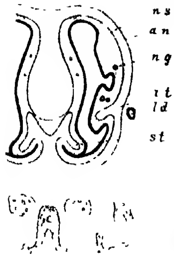

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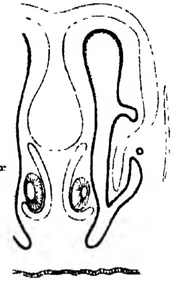

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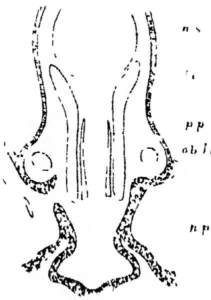

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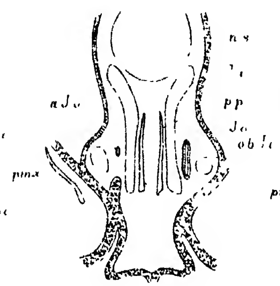

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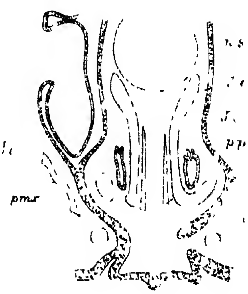

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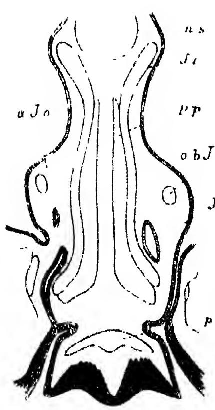

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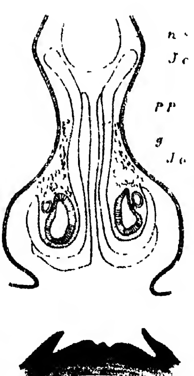

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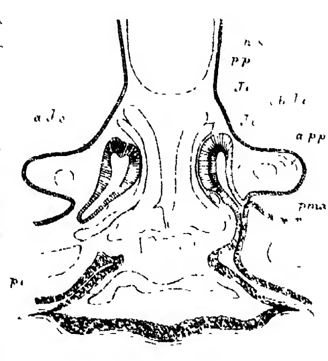

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R B del
M P Parker lith

Parker & West imp

JACOBSON'S ORGAN IN MACROSCELIDES

Parker has shown that in the allied genera *Petrodromus* and *Rhynchocyon* there are a considerable number of Marsupial characters. In the Hedgehog the organ is formed on the common Eutherian type, and I expected to find in *Macroscelides* indications of marsupial affinity. When the organ was investigated, however, it was seen to be quite different from that in any Eutherian hitherto examined, and to be typically Marsupial in almost every respect.

Before entering upon comparative observations, it will be convenient first to describe the condition of parts in *Macroscelides*.

If a section be made near the middle of the proboscis, it will be seen (Pl. XXI. fig. 2) to be formed of a ring of cartilage (*a.n.*), enclosing the two nasal passages and surrounded by soft tissues—muscles, tendons, and skin. The skeletal portion is made up of a well developed median nasal septum (*n.s.*) and two alinasals (*a.n.*), which sweep round from the upper end of the septum and meet each other interiorly. From this lower point of union of the alinasals they pass upwards to meet the lower end of the septum. From the inner side of each alinasal, near the level of the base of the septum, there passes inwards a small turbinal which is an anterior continuation of the inferior nasal turbinal; and from the point where the incurved end of each alinasal meets the base of the septum there passes downwards and outwards a second turbinal plate which may be referred to as the *septal turbinal* (*s.t.*). With very little modification, this description might refer to any section of the proboscis. On approaching the anterior end (Pl. XXI. fig. 1), however, the turbinals are found to be less developed, the nasal septum slender and fused with the alinasals inferiorly, and the upper half of the alinasals to be separated from the lower. Near the anterior nasal opening a transverse section shows a pair of alinasals above, a pair of cartilages on the nasal floor, and a pair of rather complicated lateral cartilages which apparently form nasal valves. The anterior nasal opening looks outwards and slightly downwards.

In a transverse section near the root of the proboscis, the only noteworthy differences from the more anterior sections are that the base of the septum is considerably larger, while the lower halves of the alinasals are not only separate from each other, but are distinct from the alinasals above—forming nasal-floor cartilages.

When the plane of the premaxilla is reached (Pl. XXI. fig. 3), the outer and lower part of the nasal-floor cartilage becomes lost, only the part situated immediately below the base of the septum and which forms the septal turbinal remaining.

A few sections in front of the plane where the palatine process is given off from the premaxilla, the premaxilla (*pmx.*) sends upwards a narrow plate as a support to the inner side of each of the two cartilages which lie at the base of the septum. These plates form the anterior ends of the palatine processes (*p.p.*). About this same plane the small cartilaginous plates, which in the

more anterior sections have been seen to form the septal turbinals, become detached from the inner plates.

A section immediately behind the anterior end of the palatine process shows the inner plate of the nasal-floor cartilage dipping down in the cleft between the palatine process and the premaxilla, supported on its inner side by the vertical plate of the former. The papilla is fairly large, and the naso-palatine canal is seen passing upwards and inwards by its side.

A few sections beyond this plane we see (Pl. XXI. figs. 5 & 6) that the naso-palatine canal (*n.p.c.*) on passing further upwards turns outwards as it opens into the nasal cavity. On its upward passage it receives the duct of Jacobson's organ (*J.o.*). This duct, which lies almost vertically, passes between the large vertical plate and the apparently detached outer portion of the nasal-floor cartilage and opens into Jacobson's organ near its anterior end. The organ extends very slightly in front of the point where the duct is given off.

Immediately behind the duct (Pl. XXI. fig. 7), the lower end of the vertical plate becomes attached to the outer, apparently detached, portion, forming a floor to the organ. It will thus be seen that Jacobson's cartilage has an outer bar exactly as in Marsupials.

The Jacobson's organ itself is of moderate length and presents no features of special interest in the fœtus. The posterior part of it appears to be devoid of sensory epithelium and to be merely the duct conveying the secretion from a large number of glands.

In the adult, the cartilages are essentially similar in arrangement to those in the fœtus, but an additional feature is to be observed in the presence of a well-developed cartilage in the papilla (Pl. XXI. fig. 8). The organ is in section (Pl. XXI. fig. 9) somewhat kidney-shaped, with a single large vessel running along the hilus. The sensory epithelium is confined to the inner wall, and the organ is abundantly supplied with glands (*g.*).

From the above description it will be seen that in its relations the organ has little or no resemblance to the highly specialized type met with in most Eutherians, and that all its peculiarities are those typical of Marsupials.

In the Marsupial the following may be regarded as the most typical features of this region of the head:- (1) The Jacobson's organ opens into the naso-palatine canal near the point where the canal opens into the nasal cavity; (2) the anterior part of Jacobson's organ is protected externally by a cartilaginous bar which passes from the outer edge of the lower part of Jacobson's cartilage behind to the outer edge of the upper part in front; (3) the naso-palatine canal is never supported by a cartilaginous process from the nasal-floor cartilage; (4) the nasal floor has no cartilaginous support behind the region of the naso-palatine canal; (5) the papilla has a well-developed cartilage; and (6) the Jacobson's organ has usually a single large vessel running along its outer face.

While almost all Marsupials exhibit these features, no higher mammal hitherto examined agrees with the Marsupials in more than three of these characters. The peculiar condition of Jacobson's cartilage, whereby a cartilaginous bar is present along the outer wall of the anterior part of the organ, and which I regard as a remnant of the turbinal of Jacobson's organ retained in the Monotremes, is among the Eutheria only met with in the Edentata (*Dasypus*), and in a rudimentary condition in some Rodents. Only the Edentates again agree with the Marsupials in the absence of a cartilaginous support to the naso-palatine canal. The presence of a cartilage in the papilla, though occurring in most Marsupials, has hitherto only been observed among higher mammals in the little Bat *Miniopterus*, and possibly as a rudiment in *Cavia*.

From the fact that *Macroscelides* agrees with the Marsupials in every detail of the anatomy of this region, we are forced to the conclusion that it is a very near relative of the Marsupials, and has probably very little affinity with the more typical Insectivores. That the marsupial characters are not confined to the nose we know from Parker's work. In the tympanic region and in the remarkable condition of the orbito-sphenoid the marsupial affinities are quite as remarkable.

It is further interesting that, while *Macroscelides* in the anatomy of its anterior nasal region agrees more closely with *Perameles* than with other Marsupials, *Perameles* in one or two respects agrees more closely with *Macroscelides* than with most of the typical Marsupials. The striking similarity of structure is shown in the drawing (Plate XXI.), where a section of the anterior part of Jacobson's organ in *Perameles* is shown (Pl. XXI. fig. 10) for comparison with the section of *Macroscelides* (fig. 8).

It may be noted that *Macroscelides* has a discoidal deciduate placenta, and that the young are born in a well-developed condition.

EXPLANATION OF PLATE XXI.

References.—*a.J.c.*, anterior portion of Jacobson's cartilage; *a.J.o.*, anterior portion of Jacobson's organ; *a.n.*, alinasal; *a.p.p.*, anterior spur from palatine process; *g.*, glands; *i.c.*, small isolated cartilage—possibly a rudimentary Stenson's cartilage (not indicated in the adult); *i.t.*, inferior turbinal; *J.c.*, Jacobson's cartilage; *J.o.*, Jacobson's organ; *l.d.*, lachrymal duct; *n.g.*, nasal gland; *m.x.*, maxilla; *n.p.c.*, naso-palatine canal; *n.s.*, nasal septum; *o.b.J.c.*, outer bar of Jacobson's cartilarge; *p.c.*, cartilage of papilla; *pmx.*, premaxilla; *p.p.*, its palatine process; *s.t.*, septal turbinal.

Figs. 1, 2, 3, 4. Transverse section of snout of fœtal *Macroscelides proboscideus*. × 24.
Figs. 5, 6, 7. Transverse section of the same region of naso-palatine canal. × 10.
Figs. 8, 9. Transverse section of Jacobson's organ in adult *Macroscelides*. × 18.
Fig. 10. Transverse section of anterior end of Jacobson's organ in *Perameles nasuta* (young). × 17.

Addendum (*March* 1902).—While writing this paper I had taken for granted that the cranial characters described by Parker in *Rhynchocyon* and *Petrodromus* would be common to the other

genus of the family, more especially as the inter-relationship of the three genera is apparently very close; but, on looking into the structure of the skull, I find that in both *Macroscelides proboscideus* and *M. rupestris* there is a distinct optic foramen. The marsupial characters of the tympanic region are, however, as marked in *Macroscelides* as in the other genera.

4. On some Foraminifera and Ostracoda from Cocos Keeling Atoll, collected by Dr. C. W. Andrews, 1898. By Frederick Chapman, A.L.S., F.R.M.S.[1]

[Received February 25, 1902.]

(Text-figures 27 & 28.)

On his return from Christmas Island in 1899, Dr. Andrews was good enough to submit to the writer some sands gathered between tide-marks in the Cocos Keeling Islands for examination. A casual glance at the material was sufficient to prove it worth recording, and more especially since the samples were taken both from the lagoon and from the outer side of the atoll.

Though far removed geographically, the microzoic fauna of Funafuti bears some striking analogies with the present collection, chiefly on account of the similarity of conditions in the habitats of the two faunas.

An especially noteworthy feature with regard to the gatherings now described is the frequent occurrence of the rare and occasional form *Pavonina*, chiefly on the lagoon side.

With respect to the source of these samples, Dr. Andrews informs me that those from the outer reef came from a spot at some distance from the transverse channels which communicate with the lagoon. The lagoon material came from the inner margin of the reef, and it would most likely be commingled to some extent with organisms washed in through the sea-channels; but the general facies of this series, however, points to their having lived in sheltered water.

The species of Foraminifera are numerous for such a small gathering, amounting in all to 76. Some short notes are added regarding those which are of especial interest, either on account of their rarity elsewhere or their exceptional development. None of the forms appear to be actually new, but there are many peculiar modifications in form.

The Ostracoda number 28 species, and include two new forms. They are nearly all well-known littoral species, and are fairly equally distributed both inside and outside the lagoon.

Notes on the Ostracoda from Cocos Island.

The genus *Bairdia* is represented by 8 species, one or two of

[1] Communicated by C. Davies Sherborn.

which have occurred in abyssal deposits, such as *B. milne-edwardsii* and *B. crosskeiana*. They are all, however, of far more frequent occurrence in shallow-water dredgings. A few of the species have a wide geographical range, as *B. milne-edwardsii*, *B. acanthigera*, and *B. crosskeiana*, which are also northern species. Of the 10 species of *Cythere* two are known from northern areas, namely, *C. prava* and *C. stimpsoni*. Another species, *C. dictyon*, is more often found in deep water, being recorded from fifteen out of twenty-five of the 'Challenger' dredgings at depths of 1000 fathoms and more. The remainder are well known from shallow-water dredgings. The genus *Loxoconcha* is represented by four species, three of which have a fairly wide range, namely, *L. alata*, *L. honoluliensis*, and *L. anomala*. There are three species of the genus *Xestoleberis*, two of which have a wide range; one of them, *X. depressa*, is also common in dredgings off the British coast, from the North Atlantic, and also as a post-Tertiary fossil from Scotland, Ireland, Norway, and Canada. The only species of *Cytheropteron* recorded here, namely *C. longicaudatum*, was originally described by Dr. G. S. Brady from material dredged in the Fiji group.

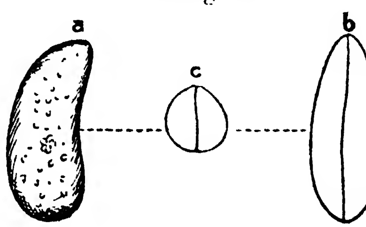
Description of New Species of Ostracoda.

(The specimens were not preserved sufficiently well to enable the organisms to be examined.)

CYTHERIDEIS ANDREWSI, sp. nov. (Text-fig. 27.)

Carapace suboval, elongate, somewhat arcuate and compressed. Dorsal margin, in side view, rather irregularly curved; ventral margin concave and sinuous. Anterior extremity produced;

Text-fig. 27.



Cythrideis andrewsi.
a, right valve, lateral view; *b*, edge view; *c*, end view. × 42 linear.

posterior evenly and broadly rounded. Edge view compressed ovate. End view subcircular. Surface of the carapace covered with fine pittings; and the muscle-spots in the median area disposed in rosette-form. Length ·57 mm.

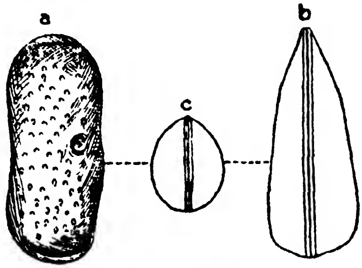
Cocos Island, lagoon; very rare.

This species differs from *C. lævata* G. S. Brady in form and also in the surface-markings on the carapace itself; but it is evidently allied in some respects.

CYTHERELLA VESICULOSA, sp. nov. (Text-fig. 28.)

Carapace subrectangular, elongate, seen from the side. Surface of carapace highest near the dorsal margin, sloping towards the ventral, with a depressed area in the middle of the valve near the ventral margin, in the lowest part of which there is a circular pit.

Text-fig. 28.



Cytherella vesiculosa.

a, right valve, lateral view; *b*, edge view; *c*, end view. × 42 linear.

Anterior part of carapace gently sloping towards the margin; posterior border steep. Edge view cuneate. End view oval. Surface of valves ornamented with numerous deeply-set pittings or cavities. Length ·76 mm.

Cocos Island, lagoon; rare.

The nearest form to this handsome species seems to be *C. semitalis* G. S. Brady; but it differs in having only a part of the carapace covered with pittings, which are not, however, exactly comparable with those in our form, and the carapace itself is also shorter and stouter. The ventero-median pit is also wanting in *C. semitalis*.

Ostracoda from Cocos Island.

	Species.	Seaward face.	Lagoon.
1.	*Bairdia tenera* G. S. Brady	r.	r.
2.	" *ventricosa* G. S. B.	r.	
3.	" ? *acanthigera* G. S. B.	...	r.
4.	" *milne-edwardsii* G. S. B.	r.	
5.	" *attenuata* G. S. B.	..	v r.
6.	" *amygdaloides* G. S. B.	...	c.
7.	" *crosskeiana* G. S. B.	f.	v.c.
8.	" *woodwardiana* G. S. B.		r.
9.	*Cythere scintillulata* G. S. B.	f.	.
10.	" *cancellata* G. S. B.	v.r.	...
11.	" *subrufa* G. S. B.	v.r.	v.r.
12.	" *cristatella* G. S. B.	r.	
13.	" *rastromarginata* G. S. B.	....	v.r.
14.	" *obtusalata* G. S. B.	......	v.r.
15.	" *wyville-thomsoni* G. S. B.	....	v.r.
16.	" *stimpsoni* G. S. B.	....	r.

f., frequent; c., common; v.c., very common; r., rare; v.r., very rare.

Ostracoda from Cocos Island (continued).

	Species.	Seaward face.	Lagoon.
17.	*Cythere prava* Baird	v.r.	v.r.
18.	„ *dictyon* G. S. B.	f.	c.
19.	*Loxoconcha alata* G. S. B.	f.	f.
20.	„ *anomala* G. S. B.	v.r.	...
21.	„ *honoluliensis* G. S. B.	v.r.	...
22.	„ *avellana* G. S. B.	v.r.	...
23.	*Xestoleberis depressa* G. O. Sars	c.	.
24.	„ *curta* G. S. B.	v.r.	...
25.	„ *margaritea* G. S. B.	.	v.r.
26.	*Cytheropteron longicaudatum* G. S. B.	v.r.	v.r.
27.	*Cytherideis andrewsi*, sp. nov.	...	v.r.
28.	*Cytherella vesiculosa*, sp. nov.	.	r.

Notes on the Foraminifera from Cocos Island.

MILIOLINA PARKERI H. B. Brady.

The examples from the present locality are quite typical. In its more irregular modifications *M. parkeri* seems to pass into *M. undosa* (Karrer). The nearest locality whence *M. parkeri* was obtained previously is off Jaffa (Robertson). It is common outside the atoll, and occurs more sparingly in the lagoon. At Funafuti it was found close to the inner margin of the lagoon.

MILIOLINA LINNÆANA (d'Orbigny).

Among the striate forms of *Miliolina* occurring at Cocos Island the above species is worthy of remark. It is very common on the lagoon side, and the specimens are of large size and very typical. On the outer reef it is extremely rare. It does not seem to have been recorded from any dredgings previously obtained from the Indian Ocean, but is common in many coral sands of the Pacific Ocean and the West Indies.

MILIOLINA FUNAFUTIENSIS Chapman.

This species, which was lately described from the lagoon of Funafuti (Ellice Islands, Pacific), occurs here in the dredgings from the outer side of the reef.

HADDONIA MINOR Chapman.

This is another species, occurring not unfrequently, which was first described from Funafuti.

PAVONINA FLABELLIFORMIS d'Orbigny.

This handsome species was for a long time after its original description by d'Orbigny almost unknown to rhizopodists, but it has of late years been recorded from several localities in the Pacific and Indian Oceans. It is noted from this particular area for the first time, and it is worthy of remark that it is found in greater abundance in the lagoon.

GAUDRYINA BACCATA Schwager.

Some very fine specimens of this peculiar and redundant form occur in the lagoon at Cocos Island. It was not met with at all on the seaward face. The previous occurrences were noted mainly from deep water; and in this connection it may be remarked that it is not uncommon to find certain forms of Foraminifera inhabiting lagoons as well as deep water, but not in intermediate conditions of depth.

SPIRILLINA TUBERCULO-LIMBATA Chapman.

This is a form lately found at Funafuti, which is of peculiar interest on account of its characters partaking of two of Brady's species, namely, *S. tuberculata* and *S. limbata*. It was found somewhat sparingly at Cocos Island both inside and outside the lagoon.

GYPSINA INHÆRENS Schultze sp.

The specimens of the above form from Cocos Island are remarkable for their deep rose-colour, derived presumably from the sarcode of the animal. This colour was a distinctive feature of Schultze's original specimens. The fact of the test being so strongly tinted points to their fresh condition when collected, for they seem to lose it very easily, judging from the rarity of its occurrence. *G. inhærens* here prefers the quieter water of the lagoon, but it is also found outside.

POLYTREMA MINIACEUM (Pallas), var. ALBA Carter.

A noteworthy feature of these gatherings was the extraordinary abundance of the white variety of the well-known *Polytrema miniaceum*. It seems restricted in its occurrence to the lagoon deposits.

Foraminifera from Cocos Island.

	Species.	Seaward face.	Lagoon.
1.	*Nubecularia bradyi* Millett ..	. ..	v.r.
2.	*Biloculina oblonga* d'Orb. . .	v.r.	.
3.	" *elongata* d'Orb. ...	. ..	v.r.
4.	" *depressa* d'Orb. .	v.r.	. ..
5.	*Spiroloculina nitida* d'Orb.	v.r.	v.r.
6.	" *grata* Terq. . .	v.c.	c.
7.	" *impressa* Terq.	v.r.	
8.	*Miliolina circularis* (Born)	v.r.	...
9.	" " var. *sublineata* Brady	... .	v.r.
10.	" *subrotunda* (Montagu) . .	......	r.
11.	" *labiosa* (d'Orb.)	v.r.	. ...
12.	" *tricarinata* (d'Orb.), var. *terquemiana* Brady	c.	. ...
13.	" *cuvieriana* (d'Orb.)	......	f.
14.	" *insignis* Brady	v.r.	. .
15.	" *boueana* (d'Orb.)	v.r.	f.
16.	" *funafutiensis* Chapman	v.r.	... .
17.	" *linnæana* (d'Orb.) . ..	v.r.	v.c.

f., frequent; c., common; v.c., very common; r., rare; v.r., very rare.

Foraminifera from Cocos Island (continued).

	Species.	Seaward face.	Lagoon.
18.	*Miliolina ferussaci* (d'Orb.)	v.c.	r.
19.	„ *bicornis* (W. & J.)	c.	v.r.
20.	„ *parkeri* Brady	c.	f.
21.	„ *undosa* (Karrer)	c.	...
22.	„ *seminulum* (Linné)	f.	f.
23.	„ *polygona* (d'Orb.)		c.
24.	„ *gracilis* (d'Orb.)	r.	
25.	„ *oblonga* (Montagu)	v.r.	
26.	„ *transversestriata* Brady	v.r.	
27.	*Planispirina exigua* Brady	v.r.	
28.	*Vertebralina striata* d'Orb.	f.	r.
29.	*Hauerina compressa* d'Orb.		v.r.
30.	*Peneroplis pertusus* (Forskål)	v.c.	v.c.
31.	„ *arietinus* (Batsch)		v.r.
32.	„ (*Monalysidium*) *cylindraceus* (Lam.)	f.	.
33.	„ (*M.*) *sollasi* Chapman	f.	
34.	*Orbitolites marginalis* (Lam.)	v.c.	v.c.
35.	„ *duplex* Carpenter		v.a.
36.	*Alveolina melo* d'Orb.	.	r.
37.	*Haddonia minor* Chapman	f.	
38.	*Textularia conica* d'Orb.	v.a.	
39.	„ *gramen* d'Orb.	c.	f.
40.	„ *siphonifera* Brady	r.	f.
41.	„ *agglutinans* d'Orb.		f.
42.	*Pavonina flabelliformis* d'Orb.	v.r.	f.
43.	*Gaudryina baccata* Schwager		v.c.
44.	*Verneuilina spinulosa* Reuss	v.c.	f.
45.	*Vaginulina legumen* d'Orb.		v.a.
46.	*Sagraina bifrons* Brady	v.r.	
47.	„ *raphanus* Parker & Jones		r.
48.	*Globigerina bulloides*, var. *triloba* Rss.	v.c.	c.
49.	„ *helicina* d'Orb.		v.r.
50.	„ *æquilateralis* Brady	v.r.	...
51.	„ *dutertrei* d'Orb.		v.a.
52.	*Spirillina inæqualis* Brady	f.	
53.	„ *tuberculo-limbata* Chapman	r.	r.
54.	„ *limbata* Brady		v.a.
55.	„ *decorata* Brady		v.a.
56.	*Cymbalopora poeyi* (d'Orb.)	v.c.	v.c.
57.	„ *tabellæformis* Brady	v.r.	v.c.
58.	„ (*Tretomphalus*) *bulloides* (d'Orb.)	c.	v.c.
59.	*Discorbina globularis* (d'Orb.)	r.	v.c.
60.	„ *polystomelloides* P. & J.	.	v.c.
61.	*Planorbulina larvata* P. & J.		c.
62.	„ *acervalis* Brady		v.c.
63.	*Carpenteria balaniformis* Gray	v.a.	
64.	*Pulvinulina menardii* (d'Orb.)	r.	v.r.
65.	„ *repanda* (F. & M.)	f.	
66.	„ *lateralis* Terq.	c.	r.
67.	*Rotalia beccarii* (L.)	v.c.	f.
68.	*Gypsina globulus* (Reuss)	v.r.	v.r.
69.	„ *inhærens* (Schultze)	f.	c.
70.	*Polytrema miniaceum* (Pallas)	v.r.	v.c.
71.	„ „ var. *alba* Carter	...	v.c.
72.	*Polystomella crispa* (L.)	c.	f.
73.	„ *macella* (F. & M.)	f.	v.r.
74.	„ *subnodosa* Munster		v.r.
75.	*Amphistegina lessoni* d'Orb. ..	v.c.	v.c.
76.	*Heterostegina depressa* d'Orb.	r.	v.c.

5. Contributions to the Ichthyology of the Congo.—I. On some new Fishes from the French Congo. By G. A. Boulenger, F.R.S.

[Received March 1, 1902.]

(Plates XXII.-XXIV.[1])

The British Museum has recently received from its excellent correspondent Mr. G. L. Bates a single fish obtained by him in the Ja River, flowing into the Sanga, an affluent of the right bank of the Congo, and this fish proves to belong to an undescribed species which requires the establishment of a new genus of Siluridæ.

At the same time the Director of the Royal Brussels Museum has entrusted me, at the request of my friend M. L. Dollo, with the study of the Congo Fishes preserved in that establishment. Among these I have found a small series of specimens coming from the Lukula River (sometimes spelt Likuala), another affluent of the right bank of the Congo, parallel to the Sanga. This series contains examples of five species:—*Marcusenius sphecodes* Sauvage, *Alestes kingsleyæ* Günther, *Auchenoglanis ballayi* Sauvage (all three previously known from the Ogowe only, and therefore new to the Congo system), and two new forms which are now described under the names of *Labeo lukulæ* and *Chilochromis duponti*.

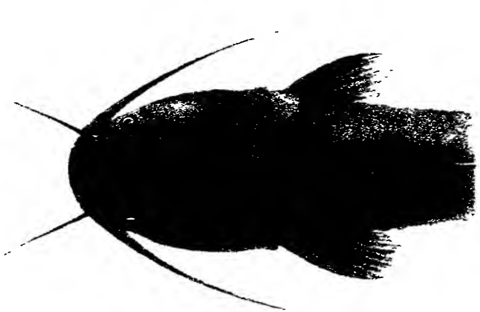
Allabenchelys, g. n.

Intermediate between *Clarias* and *Clariallabes*. Agreeing with the former in the free border to the eye, with the latter in the sides of the head being unprotected by bone.

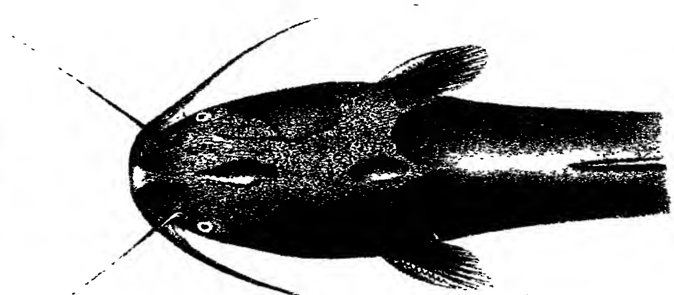
Allabenchelys longicauda, sp. n. (Plate XXII. figs. 1, 1 *a*.)

Depth of body 12 times in total length, length of head 6 times. Head $1\frac{1}{4}$ as long as broad, smooth above, the bony casque, in the middle, only one third the width of the head; postorbital shield narrow; supraoccipital process acutely pointed; a small frontal fontanelle; eye very small, its diameter 4 times in length of snout and 6 times in interorbital width; latter not quite half length of head; band of præmaxillary teeth 5 times as long as broad; vomerine teeth conical, in a crescentic band, which, in the middle, is nearly as broad as the præmaxillary band. Nasal barbel nearly half as long as head; maxillary barbel as long as head, reaching middle of pectoral spine; outer mandibular barbel $\frac{2}{3}$ length of head, inner $\frac{1}{2}$. Gill-rakers moderately long, 12 on anterior arch. Clavicles hidden under the skin. Dorsal fin with 80 rays, anal with 60, both narrowly separated from the caudal; the distance between the origin of the dorsal and the occipital

[1] For explanation of the Plates, see p. 237.



1a



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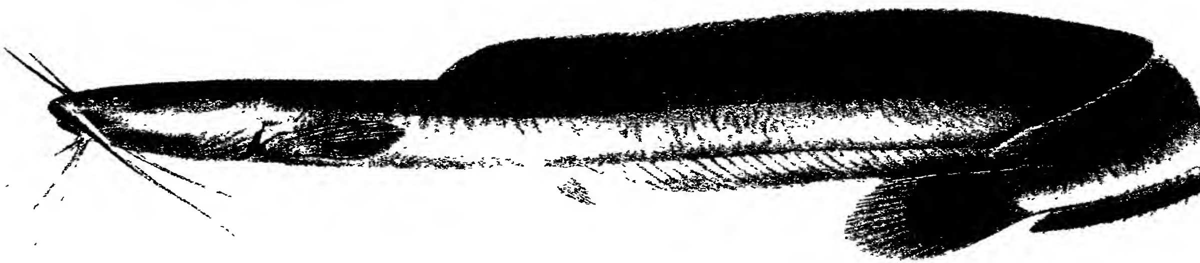
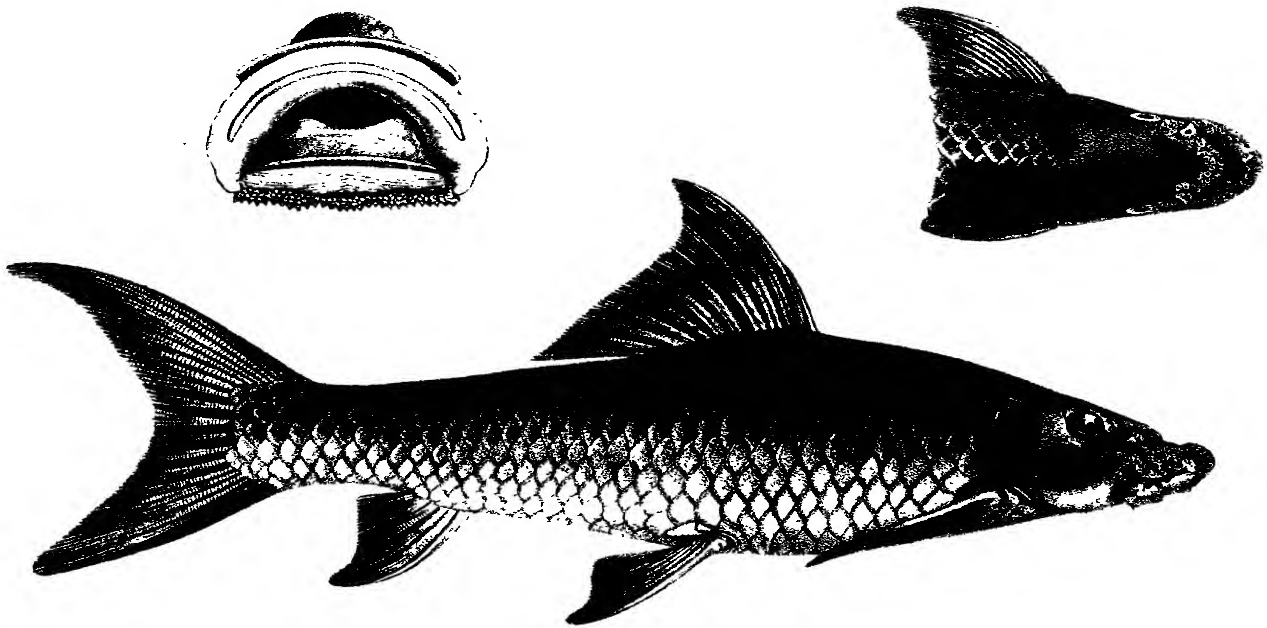


1

Mintern Bros imp

P J Smit del et lith

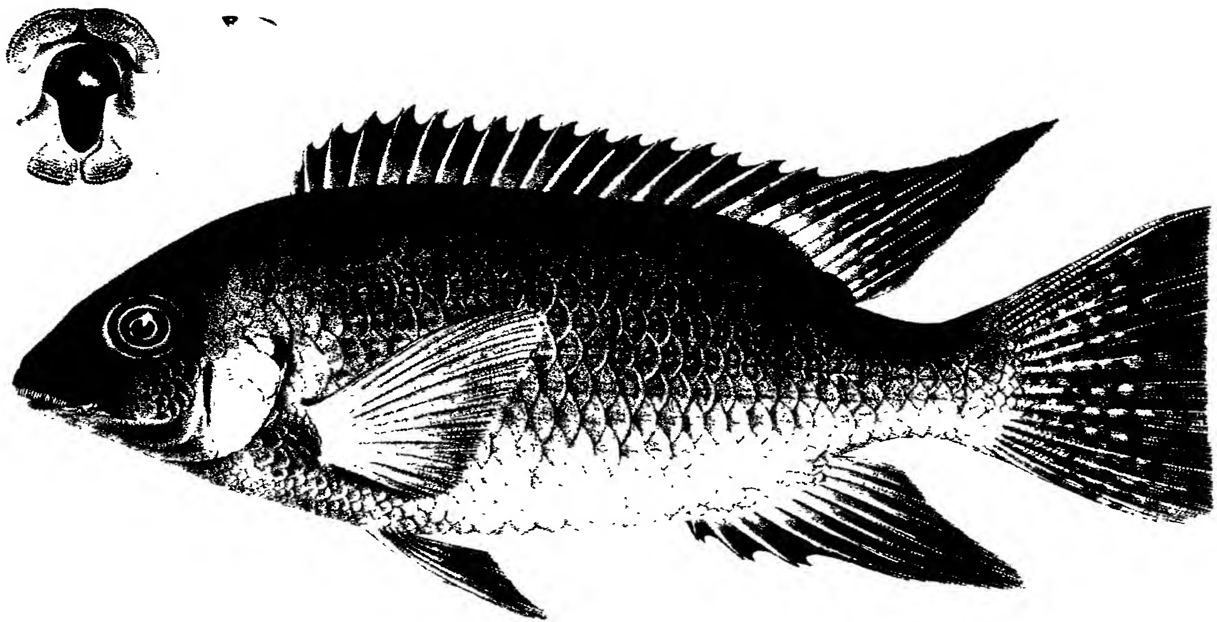
1 ALLABENCHELYS LONGICAUDA   2 CLARIALLABES MELAS



P. J. Smit del. et lith.

LABEO LUKULÆ.

Mintern Bros. imp.



P. J. Smit del. et lith.

CHILOCHROMIS DUPONTI

Mintern Bros. imp.

process $\frac{3}{5}$ the length of the head. Pectoral half the length of the head; spine smooth, $\frac{3}{5}$ the length of the fin. Ventrals small, twice as distant from the root of the caudal as from the end of the snout. Caudal $\frac{2}{3}$ the length of the head. Dark olive-brown above, whitish beneath; vertical fins dark, anal edged with white (red ?).

Total length 210 millim.

A single specimen was obtained by Mr. G. L. Bates in the Ja River, French Congo, 250 miles from the coast.

The nearest ally of this new fish is *Clariallabes melas* Blgr., from the Lower Congo, which differs, apart from the generic character of the absence of a free border to the eye, in the longer head, the more numerous rays to the dorsal and anal fins, which unite with the base of the caudal, and the presence of serrations on both sides of the pectoral spine. *Clariallabes melas* has never been figured; the upper surface of the head and of the anterior part of the body is represented on Pl. XXII. fig. 2, for comparison with *Allabenchelys longicauda*.

Labeo lukulæ, sp. n. (Plate XXIII.)

Body compressed, its depth nearly 4 times in total length; length of head $4\frac{1}{3}$ times in total length. Head once and a half as long as broad; snout obtusely pointed, strongly projecting beyond the mouth, covered with large nuptial tubercles; eye supero-lateral, in the second half of the head, its diameter 6 times in length of head, $2\frac{2}{3}$ in width of interorbital region, which is flat; width of mouth, with folded lips, half length of head; rostral flap and anterior border of lip not denticulated; posterior border of lip denticulated; inner surface of lip with numerous feeble, transverse plicæ; a minute barbel, $\frac{2}{3}$ the diameter of the eye, hidden in the folds at the sides of the mouth. Dorsal III 10, with notched upper border; the longest ray equals the length of the head and twice that of the last; fin a little nearer the root of the caudal than the end of the snout. Anal II 5; longest ray $\frac{2}{3}$ length of head. Pectoral falcate, as long as head, not reaching base of ventral. Ventral reaching vent, its first ray falling under the seventh (fourth branched) ray of the dorsal. Caudal deeply forked, with pointed lobes. Caudal peduncle once and a half as long as deep. Scales $35\frac{5\frac{1}{2}}{7\frac{1}{2}}$; 4 series of scales between the lateral line and the root of the ventral; 12 scales round the caudal peduncle. Dark olive, belly whitish.

Total length 250 millim.

A single specimen from the Lukula River, preserved in the Royal Natural History Museum, Brussels. This species is to be placed near *L. macrostomus*, *L. greenii*, and *L. nasus*, from all three of which it is easily distinguished by the number of scales round the caudal peduncle—12 instead of 16 or 18; in this character agreeing with *L. parvus*, which differs in the shorter, less prominent snout, the shorter caudal peduncle, and one series of

scales less both above and below the lateral line. The numbers of scales are as follows in the six Congo species with notched dorsal fin with 10 or 11 branched rays, supero-lateral eyes, and a single barbel on each side :—

L. falcifer Blgr.—Sq. 39 $\frac{7-8}{9-10}$, 5 between L. l. and V., 20 round caud. ped.

L. macrostomus Blgr.—Sq. 38–39 $\frac{7}{7-8}$, 4 between L. l. and V., 16–18 round caud. ped.

L. greenii Blgr.—Sq. 37–38 $\frac{6}{7}$, 4 between L. l. and V., 16 round caud. ped.

L. nasus Blgr.—Sq. 38–39 $\frac{6}{7}$, 4 between L. l. and V., 16 round caud. ped.

L. lukulæ Blgr.—Sq. 35 $\frac{5}{7}$, 4 between L. l. and V., 12 round caud. ped.

L. parvus Blgr.—Sq. 33–35 $\frac{4}{5-6}$, 3 between L. l. and V., 12 round caud. ped.

CHILOCHROMIS, g. n.

Body moderately elongate; scales cycloid. Jaws with very broad bands of bristle-like movable teeth with club-shaped inbent crowns; rami of lower jaw approximated, spatulate in front, connected with the upper jaw by a broad, thin lip; maxillary concealed under the præorbital. Dorsal with 17 spines, anal with 3.

This remarkable new genus approaches *Petrochromis* Blgr., but differs from it in the narrower lower jaw and in the teeth being simply club shaped, instead of bi- or tricuspid. I have much pleasure in naming the species in honour of the eminent Director of the Brussels Museum, one of the pioneers in the geological exploration of the Congo Basin.

CHILOCHROMIS DUPONTI, sp. n. (Plate XXIV.)

Depth of body $2\frac{1}{2}$ times in total length, length of head $3\frac{1}{2}$ times. Snout rounded, with arched profile, a little longer than the diameter of the eye, which is contained $3\frac{2}{3}$ times in the length of the head and $1\frac{1}{2}$ in the interorbital width; mouth extending to below the nostril; teeth very numerous, with reddish-brown crowns, those of the upper jaw in 8 or 9 transverse series, those of the lower jaw forming two spoon-shaped groups; the inner teeth smaller than the outer; 3 or 4 series of scales on the cheek; large scales on the opercle. Gill rakers short and slender, 15 on lower part of anterior arch. Dorsal XVII 10; last spine longest, $\frac{2}{5}$ length of head; middle soft rays longer than the head. Pectoral acutely pointed, as long as the head. Ventral not reaching the vent. Anal III 8; third spine longest, a little shorter than longest dorsal; middle soft rays $\frac{3}{4}$ length of head. Caudal fin feebly emarginate. Caudal peduncle as long as deep. Scales 33 $\frac{3\frac{1}{2}}{10}$; lat. l. $\frac{22}{10}$. Uniform olive-brown above, yellowish beneath; fins greyish.

J Smit del et lith

Mintern Bros imp

CERCOPITHECUS OTOLEUCUS

Total length 220 millim.

A single specimen from the Lukula River, preserved in the Royal Natural History Museum, Brussels.

I avail myself of this opportunity to propose the name of *Pelmatochromis polyodon* for the fish from Monsembe which I have recently described (Ann. Mus. Congo, Zool. ii. p. 53) as *P. tæniatus*, having overlooked the fact that the same name had been previously bestowed on a species from Nigeria.

EXPLANATION OF THE PLATES.

PLATE XXII.

Fig. 1. *Allabenchelys longicauda*, p. 234, $\frac{2}{3}$ nat. size.
1 *a*. " " Upper surface of head, $\frac{1}{1}$ nat. size.
2. *Clariallabes melas*, p. 235, $\frac{2}{3}$ nat. size.

PLATE XXIII.

Labeo lukulæ, p. 235, with view of open mouth, $\frac{2}{3}$ nat. size.

PLATE XXIV.

Chilochromis duponti, p. 236, with view of open mouth, $\frac{1}{1}$ nat. size

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April 15, 1902.

Prof. G. B. HOWES, LL.D., F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions made to the Society's Menagerie in March 1902:

The registered additions to the Society's Menagerie during the month of March were 146 in number. Of these 38 were acquired by presentation, 18 by purchase, 3 were born in the Gardens, and 87 were received on deposit. The total number of departures during the same period, by death and removals, was 143.

Amongst the additions attention may be specially directed to:

1. A Monkey of the genus *Cercopithecus*, procured by Major Delmé-Radcliffe in the Latuka Mountains, about a hundred miles east of the Upper Nile in Northern Uganda, and presented to the Society on March 1st. This Monkey appears to belong to a new species allied to *Cercopithecus leucampyx*, but easily distinguishable by the white ear-tufts and grey back. I propose to name it Delmé-Radcliffe's Monkey (*Cercopithecus otoleucus*). It may shortly be described as follows:—

CERCOPITHECUS OTOLEUCUS. (Plate XXV.)

Above fuliginous, back more or less grizzled with pale fulvous, head above black; frontal line white, with hairs rather elongated;

ears blackish, with a conspicuous patch of white hairs in the lower part of the conch; sides of face grizzled like the back, but more greenish; nose blackish, chin whitish; limbs and tail black; belly and underparts pale whitish grey: whole length of body about 13 in.; tail 17 in.

Hab. Forests of Latuka Mountains, Northern Uganda.

Obs. Closely allied to *C. leucampyx* of West Africa, but distinguished by its white ear-patches, blacker head, greyer back, and much paler colour beneath.

[P.S. *July 1st.*—Herr Oscar Neumann, who has examined this Monkey, is of opinion that it is nearly allied to, if not identical with, *Cercopithecus stuhlmanni* of Matschie (Sitzsb. Ges. naturf. Fr. Berlin, 1893, p. 225). This is possibly the case, but the description does not quite agree with our specimen.]

2. A Panda (*Ælurus fulgens*), from Northern India, obtained by purchase on March 4th. This scarce animal, which is the third specimen received by the Society, was in a weak state on arrival and unfortunately did not live long.

3. Another collection of ten Indian Birds, presented by Mr. E. W. Harper, F.Z.S., all belonging to species new to the Collection. Amongst them the Stork-billed Kingfisher (*Pelargopsis gurial*) and the Mountain-Thrush (*Oreocincla dauma*) are particularly interesting.

Prof. Bell, F.Z.S., exhibited two arms of an injured Starfish of the genus *Luidia*, from the west coast of Ireland, which had undergone repair at their free ends. These regenerated parts were unlike the rest of the arm, and had a striking though not exact resemblance to the free ends of the arms of an *Astropecten*.

Dr. Forsyth Major, F.Z.S., exhibited some selected specimens from a collection of fossil bones recently received by the Natural History Museum from Cyprus, where they had been discovered in caves by Miss Dorothy M. A. Bate, who started last year for that island with the express purpose of discovering and exploring ossiferous caverns.

The remains proved to be those of a pigmy Hippopotamus, about half the size of a middle-sized *Hippopotamus amphibius*, and could not be distinguished from Cuvier's "*Petit Hippopotame fossile*" (*H. minutus* Blainv.), which was smaller than the so called "*H. minutus*" of Malta and otherwise different. Cuvier's description had been based on scanty remains in the Paris Museum and from private collections in Bordeaux and Brussels, all of them without any record of their origin, but which had ultimately (Oss. Foss. 4th ed. ii. p. 490, 1834) been supposed to come from a place, never identified before nor after, between Dax and Tartas in the South of France. Dr. Forsyth Major now suggested that the fossils described by Cuvier were, in reality, from Cyprus also.

The fossils exhibited showed affinities, on the one hand, with the pigmy Hippopotamus of Western Africa, *Chœropsis liberiensis*; on the other, with some remains from the Lower Pliocene of Casino (Italy). They were considered by the exhibitor as a further illustration of the assumption that many of the Pleistocene Mammals of the Mediterranean Islands were the little modified survivors of Tertiary forms from the adjoining continents, from which the islands had been severed during that period.

The following papers were read:—

1. On the Windpipe and the Heart of the Condor. By FRANK E. BEDDARD, M.A., F.R.S., Vice-Secretary and Prosector of the Society.

[Received March 12, 1902.]

(Text-figures 29–32.)

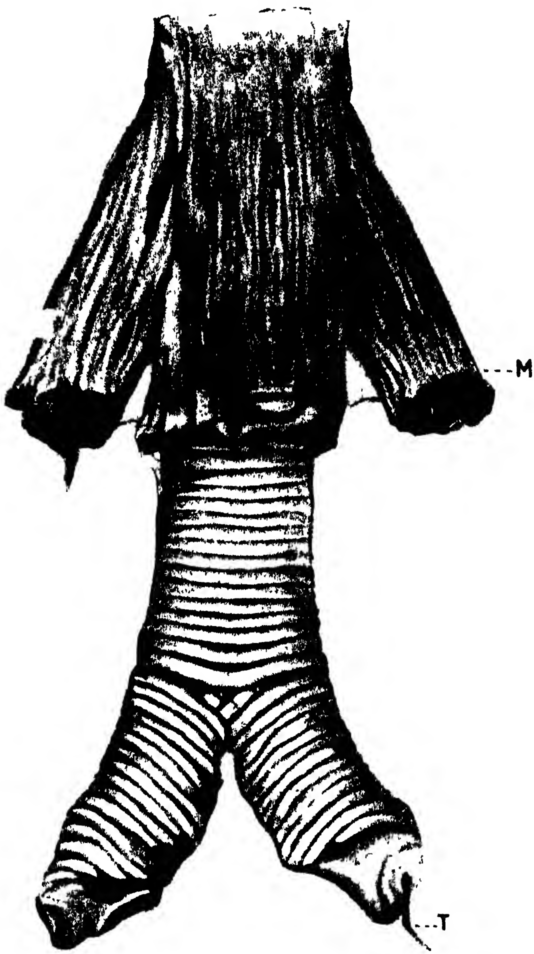
The generalities in the structure of the windpipe of the Condor are pretty well known, and have been so for long, though the information as given is not always exact. There has not been, however, so far as I am aware, a detailed comparison of that organ in the two sexes. As sexual differences in the windpipe are to be found at least in *Sarcorhamphus gryphus*, I have thought it worth while to draw up an account of the matter. In the female *Sarcorhamphus gryphus* the two bronchi end, as I described and figured them some years since[1], in a membranous tract of some length; the cartilaginous rings of the bronchi in fact cease to exist some way before the bronchi plunge into the lung-substance. This membranous tract of each bronchus is enveloped and completely covered by a layer of muscle, which is prolonged into several strands of muscle tying the bronchus down to the membranous surface of the lung. The figure of the windpipe in the female Condor illustrating my account of it was drawn from the recently dead specimen, and is, I believe, quite accurate. I have examined also the windpipe of a female example of the second species of the genus *Sarcorhamphus*, viz. *S. æquatorialis*, which I had preserved at the time of the death of this specimen. The end of each bronchus is, in precisely the same way as in *S. gryphus*, covered with a sheet of muscle. I do not give here a detailed account of the arrangement of the muscular tags proceeding from this sheath of muscle and tying down the bronchus to the lung-surface, since they appear to be, as far as I can judge, identical with the arrangements to be seen in *Sarcorhamphus gryphus*.

I have quite lately had the opportunity, through the death of one of these birds, of examining the windpipe in the male *Sarco-*

[1] "Notes on the Anatomy of the Condor," P. Z. S. 1890, p. 142.

rhamphus gryphus. I exhibit drawings of the windpipe (text-figs. 29, 30), which are quite accurate, and illustrate the various features to which I desire to direct attention. It will be seen

Text-fig. 29.

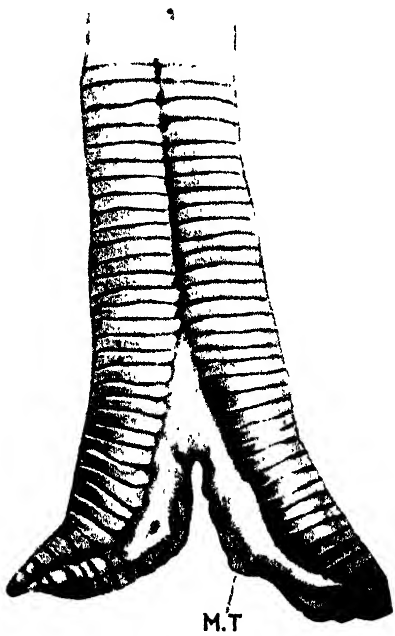


Lower end of windpipe of male *Sarcorhamphus gryphus*, front view. M, extrinsic muscles; T, muscular tag at end of bronchus.

that each bronchus ends in the male bird, as it does in the female, in an entirely membranous section of considerable length in proportion to the entire bronchus. The proportions are rightly

shown in the drawings to which I have called attention. Here, however, the resemblance ends. For in the male bird I can find no trace visible to the naked eye of the muscular sheath which covers this part of the bronchus in the hen bird. I have carefully looked for these muscles both in the fresh windpipe and after it had been preserved in alcohol. There is no doubt in my mind that the difference indicated does really exist. Moreover, the rather abundant slips of muscle, which, in the hen bird, tie down the end of the bronchus to the membranous surface of the

Text-fig. 30.



Lower end of windpipe of male *Sarcorhamphus gryphus*, back view. M.T, membrana tympaniformis.

lung, are only just recognizable in the cock bird. I found but one tiny slip (T in text-fig. 29) representing this very striking feature of the windpipe of the female. This required careful looking for; there is nothing to strike the eye forcibly.

It appears, therefore, that in *Sarcorhamphus gryphus* certainly, and in *Sarcorhamphus æquatorialis* probably, there is a marked difference between the sexes in the conformation of the syrinx; and that, in the second place, the more complicated organ is that of the female, and not of the male sex. These birds have no

proper voice, but only "hiss like a reptile." Whether the musculature of the lower part of the bronchi in the females produces any difference in the sounds uttered, I am not aware.

This is the principal fact in the structure of the windpipe of *Sarcorhamphus* to which I have desired to call attention. There is, however, another matter to which I did not give any attention in my description of the windpipe of the female Condor. Prof. Fürbringer has remarked that "Die . . . . Cathartidæ heben sich durch vollkommene bronchiale Ringe besonders hervor."[1] I have briefly referred to the fact[2] that in the members of this group there is, at least sometimes, an imperfectly formed tracheo-bronchial syrinx– imperfect in the fact that there is no great modification of the rings at the bifurcation, but suggesting a tracheo-bronchial syrinx in the incompleteness of the bronchial rings, which are indeed semi-rings. In *Sarcorhamphus gryphus* this incompleteness of the bronchial rings is very plain, as the drawing submitted herewith (text-fig. 30, p. 241) shows. Moreover, the membranous space lying between the approximated ends of the bronchial semi-rings on the dorsal aspect of the windpipe is prolonged upwards for a considerable distance along the trachea, gradually diminishing until the tracheal rings, at first incomplete, become fully complete rings passing without a break right round the windpipe. There is even—at least I so interpret it—a slight suggestion of a pessulus; this is in the shape of a small piece of cartilage, again divided into two, which lies at the point of bifurcation of the trachea into the two bronchi.

I have had an opportunity of comparing the windpipe of the Condor with that of the American Vulture, its near ally, *Cathartes atratus*, of which several specimens have recently died in the Society's Gardens. These examples were of both sexes, and I have not been able to note any sexual difference such as characterizes the Condor. In *Cathartes*, moreover, the bronchus, although it does end in a short membranous tract, is not invested with muscle as in the female *Sarcorhamphus*. In fact, the appearance of the bronchi at their termination in the lung is much like that of the male *Sarcorhamphus*. Furthermore, in each case that I examined, three muscles attached at one end to the ribs were inserted on to the surface of the lung in the vicinity of the entrance of each bronchus. It seems to be reasonable to compare these muscles, which are of course the usual lung-muscles ("diaphragm" of some authors), to those found in most birds arising from the ribs and implanted upon the membrane covering the lungs. But in addition to this comparison, it seems also possible to compare them especially with the "tags" of muscle already described in the Condor as connected with– or, indeed, arising from—the sheet of muscle covering the membranous termination of the bronchus. In *Cathartes*, however, all trace of an attachment to the bronchus itself was lost; the muscles are

[1] Untersuchungen z. Morph. u. Syst. d. Vogel, Amsterdam, 1888, p. 1086.
[2] The Structure and Classification of Birds, London, 1898, p. 482.

plainly, as in other birds, inserted on to the surface of the membrane covering the lung. Nevertheless, it appears to me that possibly the conditions obtaining in these two kinds of birds may give a clue to the origin of a portion of this musculature of the lung. I have suggested already, in my former paper upon the Condor, that the sheet of muscle enwrapping the end of the bronchus may be the remnant of an intrinsic syringeal muscle altered in function in correspondence with the degeneration of the syrinx itself. A second stage is seen in the male *Sarcorhamphus*, where the muscle is reduced to the one or two "tags" which tie down the end of the bronchus to the lung-surface. The final stage is shown in *Cathartes*, in which birds in both sexes the "tags" of muscle are present and well developed, but have entirely lost all special relation to the end of the bronchus. This, however, is at present a suggestion for the origin of those muscles, the nature and distribution of which require, and have not yet had, detailed attention in many groups of birds.

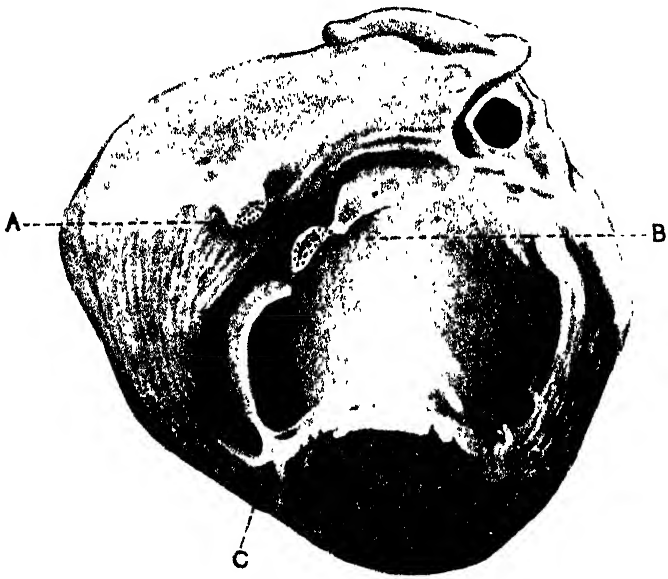
The heart of the Condor has been dealt with by Gegenbaur [1] and by myself [2]. We have both recorded the occurrence of traces of the septal flap of the right auriculo-ventricular valve, which is for the most part missing in Birds. I therefore examined with particular interest the heart of the male *Sarcorhamphus gryphus*, to the windpipe of which I have directed attention above. Gegenbaur found in a heart examined by himself "a fold . . . . which is formed by a thickening of the endocardium"; this fold was found to run backwards "from the anterior origin of the muscular valve." It is not altogether easy to follow the description given by Gegenbaur, since it is unaccompanied with any drawings. I take it, however, that what Gegenbaur saw in the heart studied by him was a prolongation of that part of the valve, arising to the left of the great papillary muscle, tying the valve to the free non-septal wall of the ventricle: to the left, that is to say, when the right ventricle is opened and looked at from in front. Now I have already brought forward reasons for considering that this part of the valve, which appears occasionally to be rather membranous in constitution and is always of thinner texture than the larger half of the valve, is the equivalent of the septal half of the valve in the Crocodile's heart [3]. A further study of the Crocodile's heart led Dr. Chalmers Mitchell and myself to the same conclusion. What Prof. Gegenbaur therefore has been able to place on record is a still greater extension of this septal half of the right auriculo-ventricular valve. In a vanishing structure such fluctuations are generally met with.

In the corresponding valve of the Monotreme heart, Prof. Lankester found considerable variations in the amount of the septal half of the valve which was present; and I do not doubt that careful measurements would prove the same thing for the

[1] "Zur vergleichenden Anatomie des Herzens," Jen. Zeitschr. ii. 1866, p. 365.
[2] P. Z. S. 1890, p. 144.
[3] "On the Structure of the Heart of the Alligator," P. Z. S. 1895, p. 348.

rudimentary septal flap of other birds. The traces of the septal flap, other than this definite piece of that flap noted by myself in the Condor's heart, consisted in "a series of tiny yellowish spots and vesicles a little way from the posterior margin of the atrio-ventricular orifice, which formed a line occupying a position identical with that which would be occupied by a septal part of the valve if it were present." These structures, possibly pathological, seemed to me and still seem, to be possibly a reminiscence of that half of the valve. Apart, however, from this pathological and thus more questionable state of affairs, we have Gegenbaur's positive assertions. In the heart which I have most recently

Text-fig. 31.



Heart of *Sarcorhamphus gryphus* opened so as to display the interior of the right ventricle.

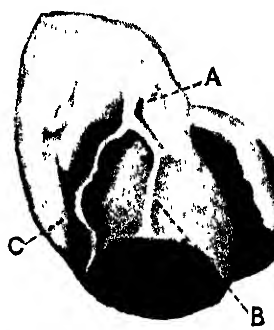
A, cut end of papillary muscle tying valve to septal wall of heart; B, opposite end of the same; C, rudiment of septal flap.

examined there were no traces, that I could discover, of an extension of the top half of the septal flap; but, on the other hand, as is shown in the drawing submitted herewith (text-fig. 31), a considerable piece of muscular tissue extended from the lower end of the invariably present portion of the valve in the direction of the rudimentary slip at its other end. A line joining the letters A and B in the drawing would make a complete septal half to this valve. It cannot, I think, be doubted that this structure is a rudiment of the chiefly missing septal half of the valve; and if

the two hearts, this one and the heart described by Prof. Gegenbaur, were to be reproduced in a composite drawing, we should in all probability see a bird's heart with a right auriculo-ventricular valve as complete as is that of the Crocodile. It may be noted, moreover, that in the Crocodile's heart (see the figures illustrating the paper by myself and that by Dr. Mitchell and myself) the portion of the septal half of the valve which is nearest to the half of the valve attached to the free wall of the right ventricle is entirely muscular, the fibrous portion of the valve lying more to the right. The comparison therefore becomes so far more exact. A still further reduction of this already reduced representative of the lower half of the septal flap of the valve might result in such small muscular pillars, arising from the ventricular septum and connecting together the two walls of the ventricle such as occur in various birds, and which I have especially called attention to in the heart of *Chunga* in my paper already quoted.

In addition to the heart of the Condor, I have had recently the opportunity of examining the heart of another bird which shows

Text-fig. 32.



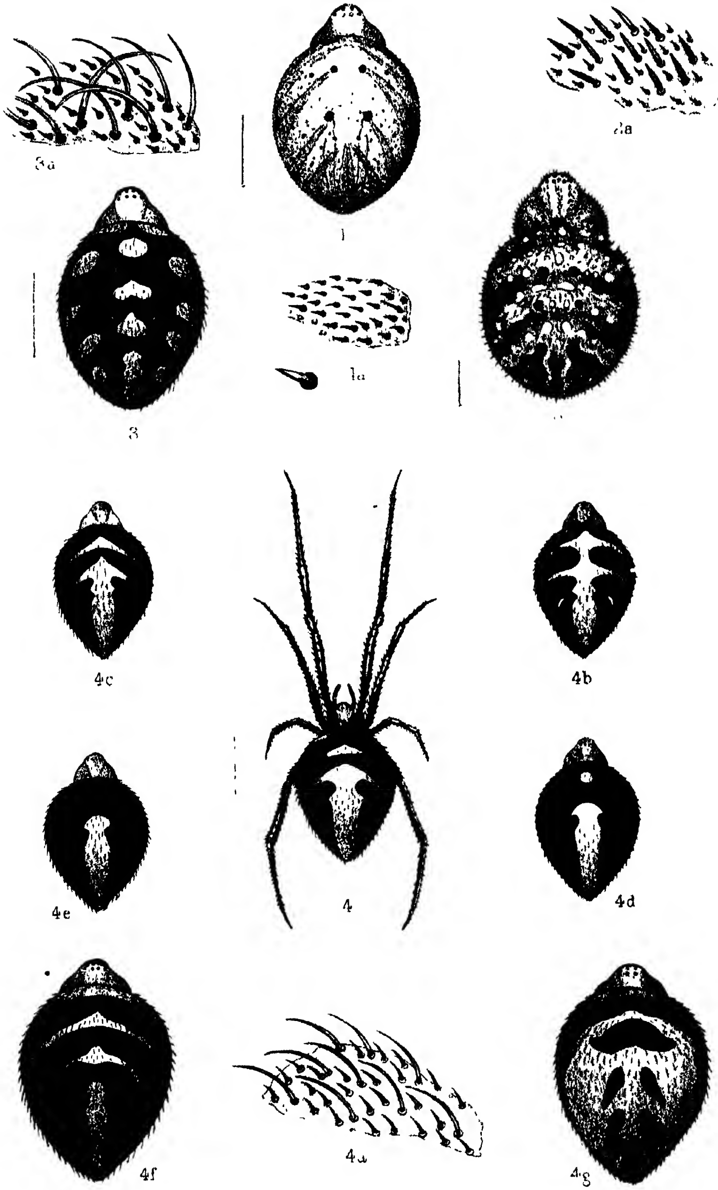
Heart of *Scythrops novæ-hollandiæ* cut open so as to display interior of right ventricle.

A, papillary muscle; B, tendinous seam extending from the same; C, valve.

some persistent traces, as I regard certain structures to be described immediately, of the missing half of the right auriculo-ventricular valve. The accompanying sketch (text-fig. 32) is a drawing of the heart of a Cuckoo (*Scythrops novæ-hollandiæ*), from which, as in the case of the Condor's heart just described, the apex has been removed. The right ventricle is cut and reflected, and the complete half of the valve shown without further cutting. From the left half of the valve, which is attached to the interventricular wall, a white seam runs down the ventricular wall in the same direction as the piece of valve from which it originates. Unfortunately, as will be seen from an inspection of the sketch, the removal of the apex of the heart has destroyed the actual ending of the seam. It could not end, however, very

far from the end of the complete half of the valve. The seam, as I call it, has hardly a muscular or tendinous appearance. It is not perceptibly raised above the muscle which forms the wall of the heart; it is only conspicuous through its decided white colour. This description, I should observe, applies to the heart after preservation in spirit. I received the whole bird from Australia in spirit some years since. But the seam is so marked, that I cannot but think that it would have been as obvious in the fresh heart as it is in that preserved in spirit. The appearance of the seam, in fact, suggests a thickening of the lining-membrane of the heart, the endocardium. It just runs on to the commencement of the left-hand piece of the muscular existing valve. Now it appears to me to be fair to construe this structure as a remnant of the otherwise chiefly missing septal flap of the atrio-ventricular valve. It may be admitted that its course is straighter than such a flap had when fully developed. But with rudimentary structures, alterations of one kind or another not related to their former functions are not uncommon. I do not, in fact, think that the length of the seam is against my interpretation of its nature. As to the possibility that it is a thickening of the endocardium, it seems to me that it is then very comparable to the "fold" described by Gegenbaur, "which is formed by a thickening of the endocardium." And Gegenbaur adds to the description that the fold in question arises "from the anterior origin of the muscular valve on the septum ventriculorum," which is precisely the origin that the seam described here by myself has. Gegenbaur's fold, however, runs "obliquely backwards and downwards," so that its position as a rudiment is more in accord with that interpretation. A final point is of some little interest. It is or has been believed that ontogenetically as well as phylogenetically the muscular or tendinous valves of higher vertebrates are first formed as simple thickenings of the endocardium, later invaded by muscle which itself later on is converted into tendon (as in higher mammals). The return, so to speak, of this rudiment of the septal half of the valve to its very earliest condition is worth emphasizing.

The facts that have just been dealt with raise another interesting question. At one time the descent of Birds from some Dinosaurian form was widely believed in; later this view lost some ground, until quite recently Prof. Osborn has recommended its serious reconsideration mainly on the grounds of the discovery of a fourth toe bent backwards, which has been shown to exist in the Dinosauria. This and some other features have added not a little to the bird-like characteristics of that group of Reptiles. On the other hand, there have not been wanting those who would assign the origin of Birds to a lower type of Reptile. The nature of the heart-valves seems to me to throw some light upon the question. At first sight, the arrangement of the auriculo-ventricular valves in the bird is more suggestive of the same valves in the tortoise than in the crocodile, the latter repre-



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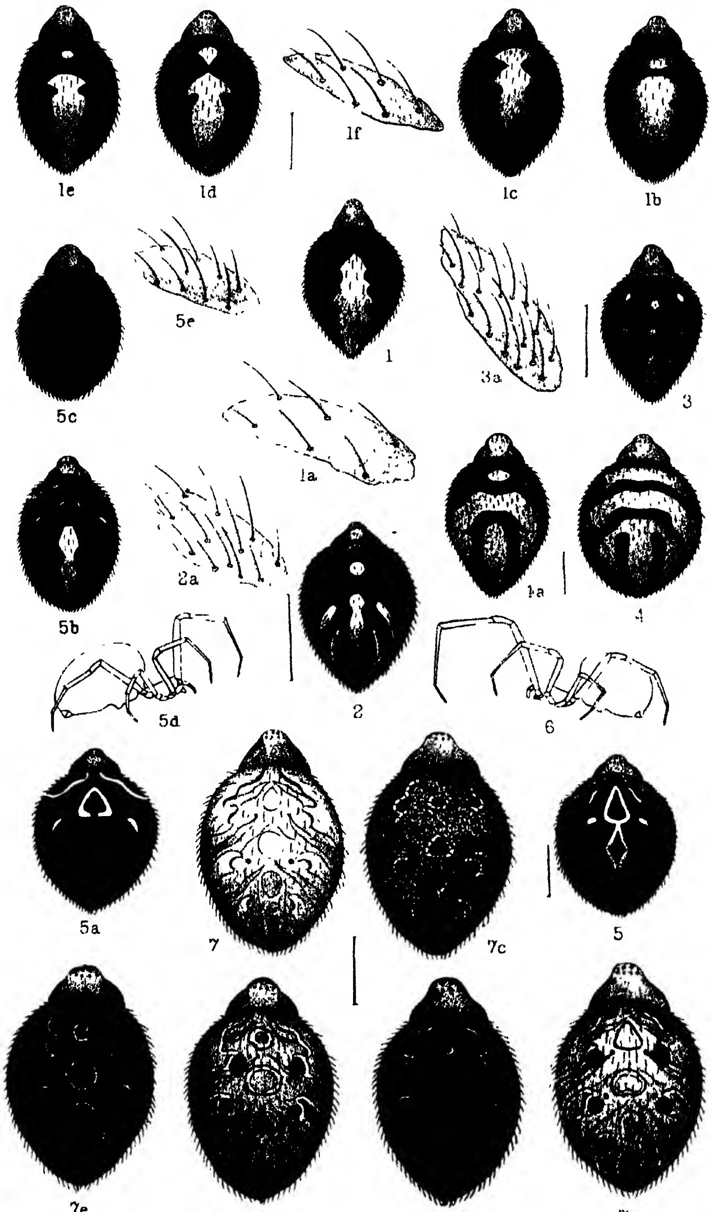
SPIDERS OF THE GENUS LATRODECTUS



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SPIDERS OF THE GENUS LATRODECTUS

senting the type of an highly-organized reptile, and nearer to the Dinosaurs than any other living type. As in the genus *Testudo*, the right auriculo-ventricular valve of the Birds is almost always a clearly-defined and semi-lunar muscular flap, practically guarding only one side of the auriculo-ventricular orifice. In *Testudo*, as in the bird, the opposite side of the ventricle has a perfectly smooth surface, without even the rudiment of a ridge to correspond to the valve which lies on the left side of the auriculo-ventricular orifice. On the other hand, the left auriculo-ventricular aperture is guarded by a completely, or nearly completely, encircling valve in both tortoise and bird. Hardly any change is required to convert the right auriculo-ventricular valve of the tortoise into that of the bird. If no rudiments, such as those described in the present communication, of a septal half to the right auriculo-ventricular valve had been discovered, it might be reasonable to dwell upon the striking but really superficial likeness which this valve in the vast majority of existing birds shows to the corresponding valve in the tortoise. But it seems now to be clear that the simple valve in the bird's right ventricle is not the persistent and simple valve of the tortoise or some lower reptilian type; but that it has been derived from the reduction of a more complicated valve such as is possessed by the Crocodiles, and was very possibly possessed by the Dinosaurs. The evidence is therefore so far in favour of assigning to the birds an origin from some highly-developed reptilian type.

2. On the Spiders of the Genus *Latrodectus*, Walckenaer.

By Frederick Pickard Cambridge, F.Z.S.

[Received February 25, 1902.]

(Plates XXVI. & XXVII.[1])

Contents.

I. Introduction.

The genus *Latrodectus* of Walckenaer (Tableau, p. 81, 1805), of which the type is *L. 4-tredecim-guttatus* (Rossi), 1790, comprises those very interesting Spiders which, under various local names, have been notorious in all ages and in all regions of the World where they occur on account of the reputed deadly nature of their bite.

As to the evidence, there can be no doubt whatever that the inhabitants of those regions suffer frequently from blood-poisoning

[1] For explanation of the Plates, see p. 261.

of a very serious nature, and that wherever the variety of *Latrodectus* occurs which is of black coloration with vivid red spots, particularly at the apex (or tail-end) of the abdomen, the blood-poisoning is ascribed to the "sting" of this spider. Of course the spider has no *sting* at the tail-end, but people who feel a sudden wound are not likely to note very carefully which end of the enemy is responsible for the damage. The tail-end being brilliant red, however, looks full of venom, and hence they have jumped to the conclusion that the sting lays there. To such an extent has this belief prevailed that in Guatemala, Mr. Sarg relates, the natives assert that the spider actually squirts out its venom at the victim, and if the fluid even touches the skin, an angry eruption will supervene. The fluid which is thus ejected is not venom, however, but merely liquid-silk, an adhesive treacly fluid which the spider squirts at a captive in order to impede its struggles for liberty. In many species of the family, Theridiidæ, to which *Latrodectus* belongs, the same phenomenon can be observed.

One may be pardoned for suspecting that the red colour has given rise to the supposition that the "sting" of these spiders is extremely venomous; and whether they are the true culprits or not, suspicion would naturally fall upon them at once amongst the ignorant and unobservant.

I have not heard that any venomous tendencies have ever been ascribed to *L. geometricus*, a large grey species, abundant in houses, outbuildings, and offices, where, if members of the genus are as bloodthirsty as has been alleged, adults and children are sure to have been bitten or "stung." I never once heard any of the natives accuse this species of stinging, or utter warnings as to the poisonous nature of its bite, though it was numerous in the houses throughout the Lower Amazons, and they were not behindhand in making the most of the dangers of the forest and the deadly nature of its inhabitants. But, then, there are no red spots on this species.

Of course it may also be argued that only those species with red spots are *poisonous*, and that the red colour is one of nature's danger signals; considerations which bring us no further towards a settlement of the question.

Mr. Crotch, writing in 1865, referring to the variety of the common European form found in Hierro, one of the Canary Islands, says that his entomological enthusiasm was checked by solemn warnings as to the dangers incurred from the bite of a certain large black lethiferous *Latrodectus malmignatus* var., generally causing death unless relieved by timely and internal doses of human excrement. A little later he remarks that, so great was the contempt induced by familiarity, that he could not be restrained from picking up the deadly monster, which, though tormented in the way presumed to be most provoking to a spider, persisted in lying inert in his hands, nor could it be induced to bite by any means.

The late Dr. Marx, too, tried many experiments on various animals by injecting the contents of the poison-sac of these spiders, but without any prejudicial results.

Numberless instances, however, have been quoted by authors of cases in which human beings, supposed to have been bitten by members of this genus, have manifested very serious symptoms. And this is especially the case in connection with the *Katipo*, the New Zealand variety. Mr. Urquhart says that his friend Mr. Robson stated that a man engaged in erecting a lighthouse was bitten on the neck, and went quite mad for some time. Mr. Wright, in 1869, gave many cases: an English boy was bitten as he sat amongst the grass inhabited by a *Katipo*; in another case the spider crawled up a boy's trousers and gave him a most dangerous wound. Carl Lumholtz, in his book 'Amongst Cannibals,' says that *Latrodectus hasseltii*, the Australian form, is very common and very dangerous to man; a friend of his, bitten in the leg, was seized with paralysis for three days. On the third day he had a cold perpsiration, and recovered.

There are said to be two kinds of *Katipo*—one black without spots, the other black with red spots; and the latter is regarded as far the most poisonous.

One might quote instances of these distressing symptoms from all parts of the globe—North America, Chili, Central America, Australia, Madagascar, New Zealand, and the Mediterranean; and I must refer readers to the cases mentioned in the 'Bulletin' of the U.S. Department of Agriculture, for Jan. 1889 and onwards (see the list of Literature), for some startling cases of blood-poisoning, possibly caused by spider-bites, though there is no evidence that the bites were inflicted by *Latrodectus*.

But for well-authenticated cases of men, women, children, and animals manifesting the symptoms of blood-poisoning, cases which have been watched for days by medical men who may be presumed to have been competent observers, we must refer to the encyclopædic work of Dr. Puga Borne, published in 1891,-2,-3. Here we have stated the age, sex, condition and temperament of the sufferers, the time of the year, and the condition of the weather at the time the patient was bitten. Then we have minute diagnoses of the symptoms, followed by a careful consideration of the various remedies and their effect.

But both in the works referred to before and in the present case, there is always a noteworthy and important omission. No mention is made as to what evidence there was that the bite was actually inflicted by the spiders accused. Dr. Puga Borne states that a sheep was bitten by five of these spiders, but he does not say how they were encouraged to bite, how they were held, or what part of the sheep was bitten. One cannot believe that so many cases could be quoted by a medical man without he had actually witnessed the act of biting, but it is an extraordinary thing that he should not have thought it worth while to tell us how the experiments were carried out and how so venomous a

creature was held when being applied to the patient! The mandibles of *Latrodectus* are so insignificant that they would, for instance, scarcely pierce the thick skin of the fingers.

In the face of so much evidence, however, one would not wish to suggest that the animals whose symptoms are described were *not* actually bitten by the spider in the presence of and under the eye of a competent observer; only one must insist that it is a great pity that, if so, this is not distinctly stated and the *modus operandi* described by Dr. Puga Borne. It is so easy to settle the point once for all, and so silence scepticism. In every case, however, which has come under my notice, it has always been taken for granted at the outset that the wound was inflicted by the spider; and this being the only point on which proof is desirable, we are given abundant evidence on the character of the subsequent symptoms and every other point except this.

A New Zealand friend of mine assured me that his friend's dog had been bitten by a *Katipo*, and fancied he had proved the case up to the hilt when he declared that he had seen the dog running round in circles on the lawn. Certainly, there must have been something seriously wrong with his friend's dog, but the lamentable symptoms described were no proof that a *Katipo* was the cause of the trouble.

One would therefore urge those who happen to be in the *Katipo* country to try and get first-hand evidence. It is not sufficient to see a *Katipo* in the neighbourhood of the tragedy, nor to see one crawling on the victim's clothes, nor even to find one crawling under the clothes of the person bitten. If a dozen healthy boys could be induced for a consideration to allow themselves to be bitten under competent observation, the matter might be settled once and for all—or, failing this, experiments might be made on mice, though one cannot suggest how the spiders are to be induced to bite in either case.

These reports of the symptoms manifested in cases coming in for treatment suffering from the supposed bite of the spider are of no value whatever as evidence as to what was the originating cause of those symptoms.

It may be interesting to gather together the various names under which the members of this genus are known in the different countries where they enjoy such evil reputation.

In New Zealand it is known as the *Katipo*; in the Philippines as the *Laualaua*; in Mexico and Central America as the *Araña capulina*, because of the resemblance which the abdomen bears to the fruit of the Capollin cherry (*Cerasus capollinus*); in Guatemala as the *Casampulga*; in Madagascar as the *Menavoudi*; in Chili as the *Pallu* or *Guina*; in Italy as the *Malmignatte*; in the Russian Steppes as the *Karakurt*; in Bolivia as the *Mico*; in Peru as the *Lucacha*; and in the Antilles as the *Araña naranja*.

I must here express my thanks to M. E. Simon, Prof. Kulczynski, Mr. H. R. Hogg, and Mr. R. I. Pocock for kindly allowing me to examine specimens of the genus; and I am also indebted

to Mr. R. Jenery-Shee, an expert in European languages, for kindly looking through Dr. Puga Borne's voluminous work in Spanish, in case I should have missed the paragraph which might have contained the evidence I required.

Of the forty-three described species referred to this genus, I am able to recognize six only as distinct, and perhaps eight as sub-species. Of the former, *L. hystrix*, *geometricus*, *pallidus*, *tredecim-guttatus*, and *mactans* are probably good species. As to the others, it is very difficult at present to take up any decided position with regard to them, as must always be the case where we have under consideration forms which are actually, at the time of observation, undergoing those processes of differentiation, under the influence of individual variability combined with that of physical surroundings, which, in these early stages, have not yet brought about any definite structural difference, or even any variation in the more superficial characters of colour-pattern, which can be considered in any way constant and exclusive.

In the subjoined table will be found the characters by which the most distinct of the species and sub-species of the female sex can best be recognized. The males are not sufficiently well known to enable one to tabulate their characters.

Females.

A. Integuments clothed with small acanthoid spines and short stiff black spines . . *hystrix* Simon.

B. Integuments clothed with fine short acanthoid spines and longer bristles, or with fine hairs only.

I. Central anterior eyes distinctly larger than the laterals . . . *geometricus* C. L. Koch.

II. Central anterior eyes not larger than the laterals.

1. Integuments almost glabrous. Latero-ventral area clothed with acanthoid spines only. Abdomen entirely creamy-white, with the black impressed muscular scars very conspicuous, and sides slashed with brownish yellow . . . . *pallidus* O. P. Cambridge.

a. Eyes of anterior row, as a rule, equidistant [1].

a[1]. Size much larger, length from 12–14 mm. Abdomen either entirely black or brown, without any red spots or with a single square or elongate-oval red spot above the anal tubercle; or with a narrow central dorsal red stripe, broken into two round spots anteriorly, and with, or without, two oblique lateral red stripes. Ventral spot dumbbell-shaped, without a decided dark spot in the middle .. .. *mactans* Fabricius.

b[1]. Size much smaller, length 7 millim. Abdomen rich brown, with three irregular transverse crimson cinctures (very variable in exact form however) and a central posterior crimson band. Ventral spot oblong-oval, with a decided dark spot or blotch in the middle.. .... { *curaçaviensis* Müller. *geographicus* Hasselt. }

[1] Characters drawn from the eye-formula are not reliable; they vary very much, even amongst examples from the same district.

b. Eyes of anterior row not equidistant, centrals nearer together than to the laterals[1].

[*Note*.—The following three species are, so far as I am able to judge from the material at hand, all of one fundamental form, namely, *tredecim-guttatus* Fabr., but they fall into certain groups more or less limited by locality. Subjoined are the characters of extreme examples.]

a[2]. Legs of first pair longer in proportion; tibia i. at least one-fourth longer than the carapace.

1. Abdomen either entirely black or brown, or with a central red band more or less broken up into distinct spots and three or more oval-elongate lateral spots. Ventral spot either absent or represented by a transverse band immediately below the genital rima, and often one above the spinners; probably also confluent, forming a larger spot .. . . *tredecim-guttatus* Rossi.
2. Abdomen black, with an oblong-oval, central, posterior apical red spot, with three very small white spots on each side. Ventral spot usually represented by a transverse bar below the genital rima .... *menavodi* Vinson.
3. Abdomen black, with a single central longitudinal red band, anteriorly either constricted or broken off to form a separate spot. Ventral spot either absent or with one or two transverse spots, or with a large dumbbell-shaped blotch . .. . *hasseltii* Thorell.

b[2]. Legs of first pair shorter in proportion; tibia i. not longer than the carapace. Spider usually smaller . . . . *katipo* Powell.

II. List of Species and Sub-species recognized in this Paper.

(For references and dates of synonyms, see Alphabetical List.)

1. Latrodectus hystrix E. Simon, 1889. (Plate XXVI. fig. 2.) (Species.)

This form is quite distinct from any others that have been taken in any part of the world, being clothed with short, stiff, stout black spines, and cannot be mistaken for anything else. Posterior row of eyes straight, approximately equidistant; centrals one diameter from each other, slightly further from the laterals. Posterior centrals much larger than the anterior centrals. Central anteriors less than one diameter apart, one diameter from the laterals, and distinctly smaller. Laterals half a diameter apart.

The example figured was kindly lent by M. E. Simon, and another example was found by Col. Yerbury at Aden.

Hab. Aden (*Simon* and *Yerbury*).

2. Latrodectus geometricus C. L. Koch, 1841. (Plate XXVII. fig. 7.) (Species.)

Synonym. *L. zickzack* (Karsch), sub *Theridium*.

This form is more distinct from the others than any except

[1] See note on p. 251.

L. hystrix. See figures of the abdominal pattern. The central anterior eyes are always, in all the examples which have come before me, slightly larger than the laterals; and, though I am unable to find any real difference in the form of the palpal organs of the male, yet the vulva of the female is distinctly different from that of *L. mactans.* The egg-cocoon is also characteristic, being covered with small silky cusps, unlike that of *L. mactans*, which is of smooth silk.

This species I found commonly in the angles of windows in the towns and villages throughout the Lower Amazons. Specimens exhibit every variety of coloration from grey to black.

Hab. SOUTH AMERICA: San Pedro and Rio Apia, Paraguay, San Domingo and Curaçao (*Simon*); Brazil (*Keyserling*); Rio Janeiro (*Göldi*); Minas Geraes (*Rogers*); Lower Amazons, Santarem, etc. (*F. P. Cambridge*). AFRICA: Khartoum (*Voission*); Abyssinia, Mozambique, and Madagascar (*Simon*); Cape Colony, Table Mountain (*Hull*); Jansenville (*Miss Leppan*); Cape Verde Islands (*F. P. Cambridge*). INDIA: Kurrachee and Manora (*Townsend*). AUSTRALIA: Melbourne (*Hogg*).

3. LATRODECTUS PALLIDUS O. P. Cambridge, 1872. (Plate XXVI. fig. 1.) (Species.)

Hab. Plains of Jordan (*O. P. Cambridge*). Persian Gulf, Bushire (*Kurrachee Museum*).

4. LATRODECTUS MACTANS (Fabr.), 1775. (Plate XXVII. fig. 2.) (Species.)

Synonyms. Abbot's Drawings: 191, 194, 195, 395, 344.—*L. formidabilis* Walck. —*L. variolus* Walck.—*L. intersector* Walck.—*L. formidabilis* Nicolet.—*L. variegatus* Nicolet.—*L. thoracicus* Nicolet.—*L. zorilla* (Walck.), sub *Tetragnatha.* —*L. dotatus* C. L. Koch.—*L. verecundum* (Hentz).—*L. lineatum* (Hentz).—*L. apicalis* Butler.—*L. carolinus* Butler.—*L. malmignathus*, var. *tropica* Van Hasselt.

With regard to this form, after examining numerous examples from North America and Central America and a few from Peru, I have come to the conclusion that originally it was derived from the same stock as *tredecim-guttatus* Rossi; and that whatever small differences there are between the two now, they are the result of long separation and different surroundings. The only differences which appear to me to be constant, lie in the relative position of the eyes of the anterior row and the hairy clothing of the abdomen. It is true that the abdominal pattern is different, the lateral spots being elongate-oval, or long narrow stripes, instead of more rounded and shorter, as in *tredecim-guttatus*; but since there is every variety of coloration, from those which are entirely black, or have only the apex of the abdomen red, to those which are fully striped with red, one cannot regard colour-characters as of specific importance.

5. LATRODECTUS CURAÇAVIENSIS (Müller), 1776. (Plate XXVII. fig. 4.) (Sub-species.)

Synonym. *L. geographicus*, Van Hasselt.

The two females, referred by M. Simon to the former name, from Asuncion, and kindly lent me for examination, are adult, and represent a type of coloration often found in the immature of *L. mactans*. This form has the abdomen mainly red, with a pair of parallel black longitudinal bands posteriorly, and two or more transverse black cinctures anteriorly. The type of coloration is the same as that of some males and females which I took on the sandy campos near Santarem, on the Lower Amazons; and the latter are unmistakably like Van Hasselt's figure of *L. geographicus*, though the precise form of the coloration differs.

But, in this case again, though the Spiders are very much smaller, I am unable to find any really reliable difference in the papal organs or in the vulva from those of *L. mactans*. Differences may indeed exist, and possibly with several dozen examples to compare, instead of two or three, one might find them.

At present, however, I can only regard this form as a dwarf race with different form of coloration, and for the time being must consider it as a sub-species.

Hab. CURAÇOA, West Indies (*Müller*); PARAGUAY: Asuncion, San Pedro and Rio Apa (*Simon*); SURINAM (*Van Hasselt*); AMAZONS (*F. Cambridge*).

6. LATRODECTUS TREDECIM-GUTTATUS (Rossi), 1790. (Plate XXVI. fig. 3.) (Sub species.)

Synonyms. *L. malmignatus* Walck. *L. martius* Aud. in Sav. —*L. argus* Aud. in Sav.- *L. venator* Aud. in Sav. *L. erebus* Walck.—*L. lugubre* (Dufour, sub *Theridion*).—*L. oculatus* Walck.—*L. conglobatus* C. L. Koch.—*L. lugubris* Motsch.—*L. hispida* (C. L. Koch), sub *Meta*.

This is perhaps the best known form, being common all through the South of Europe, the Mediterranean region, Northern Africa, and through South Russia and Syria. It is notorious in all parts of this region for its venomous bite.

The only real distinction I can find between the "*forma principalis*" of 13-*guttatus* and *mactans* is that in the *female* the lateral anterior eyes are further from the centrals than these are from each other, and the hairy clothing is much finer. In the *males*, however, there is no difference in this respect. This character (the eye-formula), moreover, is *not constant* in the females of either *mactans*, *tredecim-guttatus*, or *hasseltii*. I can find no tangible difference between the various parts of the palpal organs in the male, or of the vulva in the female, of these forms (*hasseltii* ♂ is unknown to me).

I believe these to be all offshoots of one original form, for which the oldest name is *mactans*.

Hab. EUROPE: Spain, Italy (*Walck.*); Greece (*C. L. Koch*);-

France, Morbihan; Vendée; Vaucluse, Avignon; Hérault (*Simon*);—Hungary, Croatia (*Kulczynski*);—Italy, Tuscany (*Doria*);—Sardinia, Corsica (*Walck.*, *Simon*);—S. Russia, Sarepta (*Motsch.*).

ASIA MINOR (*Simon*);—Arabia (*Dr. Anderson*);—Syria (*Simon*);—Persian Gulf, Bushire (*Moore*).

ATLANTIC ISLANDS: Canaries (*Lucas*);—Madeira, Porto Santo (*Kulczynski*, *Grant*).

AFRICA: Egypt, Alexandria (*Walck.*, *Aud. in Sav.*, *Simon*, etc.).

7. LATRODECTUS MENAVODI Vinson, 1863. (Plate XXVII. fig. 3.) (Sub-species.)

This form, resembling the Australian examples (*hasseltii*) in size, but having the vestiges of the dorso-lateral spots characteristic of 13-*guttatus*, consisting of small red spots, is peculiar to Madagascar and the neighbouring islands. I am quite unable to distinguish the female from either 13-*guttatus* or *hasseltii*, but so far I have had no opportunity of examining the male. I am inclined, however, to believe that it is simply a local variety of 13-*guttatus*, the European form of *mactans*.

Hab. Madagascar (*Vinson*).

8. LATRODECTUS HASSELTII Thorell. (Plate XXVI. fig. 4; Plate XXVII. figs. 1, 6.) (Sub-species.)

Synonyms. *L. scelio* Thorell.—*L. cinctus* Blackwall.—*L. indicus* Simon.—*L. elegans* Thor.

This distinct-looking form is essentially *L. menavodi*, which has lost the small dorso-lateral spots, leaving only a narrower (Australia, etc.), or broader and foliated (Loyalty Islands), red band down the posterior dorsal central line.

Hab. AUSTRALIA: Rockhampton; Bowen (Port Denison); Cape York (*Thorell*); —New Caledonia (*Simon*);—New Guinea (*Turner*);—New Holland (*Kulczynski*); —Loyalty Islands, Lifu (*Creagh*);—N. Britain (*Brit. Mus.*);—New S. Wales, Hill Grove; N. Queensland, Muldiva (*Broom*); N.W. Australia (*Beckett*);—Adelaide (*Meldola*). AFRICA: Shiré River; Zambesi (*Blackwall*); Lake Nyassa (*Brit. Mus.*); Bogos, Scioa or Shoa (*Pavesi* and *Antinori*) Graham's Town, Tea Fountain (a dark variety with only a minute red apical spot and a few black blotches), Jansenville, Cape Colony (*Brit. Mus.*). ASIA: Persian Gulf, Bushire (*Moore*); N. Guzerath; Poona; Mascat; Kurrachee (*Simon* and *Brit. Mus.*).—BURMAH (*Fea*).

9. LATRODECTUS KATIPO Powell. (Plate XXVII. fig. 5.) (Sub-species.)

There is a decided tendency towards a shortness of the first pair of legs amongst specimens from different parts of Africa, Australia, India, and New Zealand. This is most noticeable amongst examples from New Zealand, and, together with the tendency, the examples are as a rule smaller, and the anterior

portion of the abdomen inclines to be marked by indistinct narrow, transverse, pale cinctures, as in an example from Abyssinia; while the markings on those from New Zealand more resemble, though very indistinctly, those of *geometricus*.

In the case of these examples there are unfortunately no males. But although the first pair of legs in the New-Zealand examples are distinctly shorter in proportion than those of *L. hasseltii* from Australia, yet this character is found also, in varying degrees, amongst examples from Australia and India, so that one cannot regard it as constant.

Hab. New Zealand: Portland Island, Hawkes Bay (*Robson*); Canterbury (*Brit. Mus.*).

III. *Alphabetical List of Described or Figured Species of the Genus* Latrodectus.

Latrodectus. Abbot's figures 191 ♀, 194 ♀, 195 ♀, 395 ♂ ad., 344 ♂ juv. All these are varieties of *L. mactans* Fabr. (Abbot's drawings in Brit. Mus. Nat. Hist. 1792).

Latrodectus apicalis A. G. Butler, 1877.

Proc. Zool. Soc. Lond. 1877, p. 75, pl. xiii. fig. 2, etc. *Hab.* Galapagos Islands. Type in coll. Brit. Mus.—A variety of *L. mactans* Fabr.

Latrodectus argus Aud. in Sav., 1825 27.

Savigny's 'Égypte,' p. 137, pl. 3. fig. 10. *Hab.* Alexandria.—This is *L. tredecim-guttatus* (Rossi).

Latrodectus carolinus (A. G. Butler), 1877.

Proc. Zool. Soc. Lond. 1877, p. 75, pl. xiii. figs. 3, 3 *a*, 3 *b*. *Hab.* Charles's Island, Galapagos. Sub *Theridion*.—An immature female of *L. mactans* Fabr.

Latrodectus cinctus Blackwall.

Ann. Mag. Nat. Hist. (3) xvi. p. 341 (1865). *Hab.* Shiré River, South-east Africa, Zambesi. Also Bogos and Scioa (Shoa).—This species is clearly a variety of the form called by Thorell *hasseltii*. I have before me a young female from Shoa, referred by Pavesi to "*cinctus*," which agrees with Blackwall's description. The form of the markings coincides also with that of Thorell's cotype of *scelio* from Cape York, which is now before me, the only difference being that there is a single transverse bar beneath, similar to that obtaining in the form called *menavodi* and also in some examples of *tredecim-guttatus*. The shortness of leg i. in proportion to the length of the carapace brings it nearer to the *katipo* variety of *hasseltii* which is found in New Zealand, etc.

Latrodectus conglobatus C. Koch, 1838.

Die Arachniden, iv. p. 41, fig. 274. *Hab.* Greece.—A variety of *L. tredecim-guttatus* Rossi.

LATRODECTUS CURAÇAVIENSIS (Müller), 1776.

Linn. Vollst. Nat.-Syst. Supp., Reg. Band, p. 342. 1776 (sec. Keyserling). *Hab.* Curaçoa.—E. Simon, Boll. Mus. Zool. Anat. Comp. Univ. Torino, vol. xii. no. 270, Feb. 4, 1897. *Hab.* Ascuncion, San Pedro and Rio Apa, Paraguay.—This species, of which M. Simon has kindly sent me examples, is, so far as coloration goes, similar to varieties of *geographicus* Hasselt. The present name has priority.

LATRODECTUS CURASSAVICUM (Hêring). *Hab.* Ozam.

(I am at present unable to indicate this reference.)

LATRODECTUS DISTINCTUS Blackwall, 1859.

Ann. Mag. Nat. Hist. (3) iv. p. 260. *Hab.* Madeira.—Belongs, according to Thorell, to the genus *Lithyphantes*, possibly = *L. nobilis* Thor.

LATRODECTUS DOTATUS C. Koch, 1841.

Die Arachniden, viii. p. 115, fig. 683. *Hab.* North America.—Identical, according to Koch, with *Tetragnatha zorilla* Walck. Both these forms are obviously males of *L. mactans* Fabr.

LATRODECTUS ELEGANS Thor., 1898.

Ann. Mus. Genova, (2) xix. p. 293, ♀. *Hab.* Burmah.—Probably a variety of *L. hasseltii*; resembling *L. cinctus* Blackw., a form I have seen from Shoa.

LATRODECTUS EREBUS Walck., 1837.

Insectes Aptères, i. p. 646. *Hab.* Egypt, Spain.—Dark variety of *L. tredecim-guttatus* Rossi.

LATRODECTUS FORMIDABILIS Walck., 1837.

Insectes Aptères, i. p. 647, ♀. *Hab.* Georgia.—Undoubtedly *L. mactans* Fabr.

LATRODECTUS GEOGRAPHICUS Van Hasselt, 1888.

Tijd. voor Ent. xxxi. pt. 3, pp. 165 200, pls. v. & vi. (1888). *Hab.* Surinam.—This is, so far as size and pattern of colouring, a distinct species. I have taken the adult male and female on the sandy campo, at the roots of grass and under overhanging ledges, near Santarem on the Lower Amazons. It is, however, difficult to justify the apparent specific distinction by any tangible structural difference. The form may finally be relegated to the position of a local race, and perhaps be regarded as a sub-species.

LATRODECTUS GEOMETRICUS C. L. Koch, 1841.

Die Arachniden, viii. pp. 115–117, fig. 684.

This is perhaps one of the most distinct and easily recognizable of the species, the larger size of the anterior central eyes being constant. The colour varies from pinky grey to nearly black.

LATRODECTUS HASSELTII Thor., 1870.

Kongl. Svenska Akad. Förhandl, 1870, no. 4, p. 369. L. Koch, Arach. Austr. 1871, p. 276. *Hab.* New Holland; Rockhampton; Bowen (Port Denison).—This species is undoubtedly identical with *scelio* Thor.

LATRODECTUS HISPIDUS (C. Koch), 1836.

Die Arachniden, iii. p. 9, fig. 166. Sub *Meta*. *Hab.* Greece.—Probably identical with *L. tredecim-guttatus* (Rossi).

LATRODECTUS HYSTRIX E. Simon, 1889.

Ann. Soc. Ent. Fr. (6) x. p. 99 (1889). *Hab.* Yemen (*Simon*); Aden (*Yerbury*).—A very distinct species, recognizable by its straight posterior row of eyes, and abdomen clothed with short, stiff bristles.

LATRODECTUS INDICUS E. Simon, 1897.

Mém. Soc. Zool. Fr. x. p. 252 (1897). (SCELIO, var. *indica*.) *Hab.* North Guzerath.—Bull. Mus. d'Hist. Nat. no. 7, p. 289 (1897). *Hab.* Mascat, Kurrachee.—Pocock, Arach. Ind. p. 23, fig. 80 (1900). This is a variety of *L. hasseltii* = *scelio* Thor.

LATRODECTUS INTERSECTOR Walck., 1837.

Insectes Aptères, i. p. 649. *Hab.* America.—Undoubtedly a variety of *L. mactans* Fabr.

LATRODECTUS KATIPO Powell, 1870.

Trans. New Zealand Institute, iii. p. 57. *Hab.* New Zealand.—The relatively shorter legs of the first pair, and the straightness of the posterior row of eyes, in the female (I have not seen the male), would suggest at first that this is a distinct species and not identical with *hasseltii* Thor. = *scelio* Thor., but I find that this character is not by any means constant. The hairy clothing on the abdomen furnishes, however, a very good distinctive character.

LATRODECTUS LINEATUS (Hentz), 1850.

Boston Journ. Nat. Hist. vi. p. 281, pl. x. fig. 3.—'Spiders of the United States,' ed. Burgess, p. 153, pl. 17. fig. 3. Sub *Theridium*. *Hab.* North America.—A variety of *L. mactans* Fabr.

LATRODECTUS LUGUBRIS (Dufour), 1820.

Ann. Gén. Sci. Phys. iv. p. 355, pl. lxix. fig. 1. Sub *Theridion*. —Identical with *L. erebus* Walck. & Aud. in Sav. = *L. tredecim-guttatus* (Rossi).

LATRODECTUS MALMIGNATUS Walck., 1837.

Insectes Aptères, i. p. 642. *Hab.* Corsica, Sardinia, Italy.—Variety of *L. tredecim-guttatus* (Rossi).

LATRODECTUS MARTIUS Aud. in Sav., 1825–27.

Savigny's 'Égypte,' p. 137. *Hab.* Italy (*Walck.*); Egypt.—

Variety of *L. tredecim-guttatus* (Rossi)? According to Thorell this belongs to the genus *Lithyphantes*.

LATRODECTUS MENAVODI Vinson, 1863.

Aranéides Réunion, etc. p. 122, pl. viii. fig. 5. *Hab.* Madagascar.—This form may be regarded as a sub-species, or local race.

LATRODECTUS OCULATUS Walck., 1837.

Insectes Aptères, i. p. 645. *Hab.* Alexandria.—A variety of *L. tredecim-guttatus* (Rossi).

LATRODECTUS ORNATUS Lucas, 1845.

Histoire d'Algérie, p. 233, pl. 14. fig. 8. *Hab.* Algeria.—According to Thorell it belongs to the genus *Lithyphantes*.

LATRODECTUS PALLIDUS O. P. Cambr., 1872.

Proc. Zool. Soc. Lond. 1872, p. 287 (♀). *Hab.* Plains of Jordan (*O. P. C.*); Bushire, Persian Gulf (*Kurrachee Museum*).—The two females from the Kurrachee Museum are undoubtedly identical with *L. pallidus* O. P. C. The dull yellow colour of the abdomen (which is almost entirely devoid of hairs), with the slashed pattern on the sides and the conspicuousness of the four impressed dots on the anterior dorsal area, renders it easily to be recognized from any other form. The posterior row of eyes is almost or quite straight, and the lateral anteriors are nearer the centrals than these are to each other.

LATRODECTUS PERFIDUS Walck., 1837.

Insectes Aptères, i. p. 647. *Hab.* Georgia.—Probably *L. mactans*.

LATRODECTUS QUINQUEGUTTATUS Krynicki, 1837.

Bull. Soc. Imp. Nat. Moscou, p. 75, tab. vi. fig. 2. *Hab.* S. Russia.

LATRODECTUS SCELIO Thorell, 1870.

Kongl. Svenska Vet.-Akad. Förhandl. 1870, no. 4, p. 370. L. Koch, Araneiden Australiens, 1871, p. 279. E. Simon, Mém. Soc. Zool. Fr. x. p. 252, 1897. *Hab.* New Caledonia (*François*); Muscat, Kurrachee; and North Guzerath, Central Asia (var. *indica* Sim.).—This form is undoubtedly identical with *hasseltii* Thor., the latter name taking priority.

LATRODECTUS SCHUCHII (C. L. Koch), 1836.

Die Arachniden, iii. p. 10, fig. 137. *Hab.* Greece. Sub *Meta.*—Thorell, Kongl. Svenska Vet.-Akad. Hand. Band xiii. no. 5, p. 68. E. Simon, Bull. Soc. Zool. Fr. ix. 1884, p. 21, note. Pavesi, Ann. Mus. Genova, xv. p. 333 (1880), Tunis. E. Simon, Arach. France, vol. v. p. 179 (1881), note.

I do not know this species. A male and two females, which

were kindly sent by M. Simon under this name, I am quite unable, at present, to separate from *tredecim-guttatus*. Simon thinks (Arachn. France, vol. v.) that this form may be identical with *pallidus* O. P. Cambridge.

Hab. Greece (*C. L. Koch*); Algeria, Spain, and Senegal (*Simon*); Spain, Torrevieja (*Thorell*); Shoa and Tunis (*Pavesi*).

LATRODECTUS SPINIPES Lucas, 1845.

Hist. d'Algérie, p. 233, pl. 14. fig. 9. *Hab.* Algeria (*Lucas*).—This is possibly either an *Asagena* or a *Pœcilochroa* (Drassidæ).

LATRODECTUS THORACICUS Nicolet, 1854.

Gay's Histoire de Chile, p. 461. *Hab.* Chili (*Nicolet*).—Probably a variety of *L. mactans* (Fabr.).

LATRODECTUS TREDECIM-GUTTATUS (Rossi), 1790.

Fauna Etrusca, vol. ii. p. 136, tab. ix. fig. 10.

This species is the common Mediterranean form of which *L. erebus* Walck. is the dark unicolorous black variety.

Hab. Italy, Corsica, Sardinia, Spain, N. Africa, Greece, S. Russia, Madeira, etc., etc.

LATRODECTUS TROPICUS Van Hasselt, 1860.

Tijdschrift voor Entomologie, iii. p. 46, pl. 5. *Hab.* Curaçoa.—Probably a small variety of *L. geographicus* Hasselt.

LATRODECTUS VARIEGATUS Nicolet, 1854.

Gay's Histoire de Chile, p. 461, pl. 4. fig. 9. *Hab.* Chili.—Probably a variety of *L. mactans* Fabr.

LATRODECTUS VARIOLUS Walck., 1837.

Insectes Aptères, i. p. 648. *Hab.* Georgia.—Variety of *L. mactans* Fabr.

LATRODECTUS VENATOR Aud. in Sav., 1825-27.

Savigny's 'Égypte,' p. 138, pl. 3. fig. 11. *Hab.* Egypt.—Variety of *L. tredecim-guttatus* (Rossi).

LATRODECTUS VERECUNDUS (Hentz), 1850.

Boston Journ. Nat. Hist. vi. p. 280, pl. x. figs. 1 & 2. Sub *Theridion*. *Hab.* N. America.—A dark variety of *L. mactans* (Fabr.), having the same relation to it as *L. erebus* bears to *L. 13-guttatus*.

LATRODECTUS ZICKZACK (Karsch), 1878.

Zeits. gesammt. Naturwiss. li. p. 311 (1878). Sub *Theridium*. *Hab.* Zanzibar.—Variety of *L. geometricus* C. Koch.

LATRODECTUS ZORILLUS (Walck.), 1837.

Insectes Aptères, Atlas, pl. 19. figs. 2 B, 2 *d*, 2 D. Sub *Tetragnathe zorille*, ♂ ad.—Obviously *L. mactans* Fabr.

IV. EXPLANATION OF THE PLATES.

PLATE XXVI.

Fig. 1. *Latrodectus pallidus*; Bushire: p. 253. Dorsal view of female. 1 *a*. A portion of the integument from the lateral region of the abdomen, showing acanthoid spines.

2. *Latrodectus hystrix*; Yemen: p. 252. Dorsal view of female. 2 *a*. Integument of abdomen, showing acanthoid and stouter straight spines.

3. *Latrodectus tredecim-guttatus*; Tuscany: p. 254. Dorsal view of female. 3 *a*. Integument of abdomen, showing acanthoid and long curved spines.

4. *Latrodectus hasseltii*: p. 255 (co-type of *L. scelio* Thor., Cape York). Dorsal view of female. 4 *a*. Integument of abdomen, showing acanthoid and longer spines. 4 *b*. Dorsal view of female variety from New Britain. 4 *c*. Another variety from the same locality. 4 *d*. Another variety from Fort Bowen. 4 *e*. Variety from South Australia. 4 *f*. Variety (probably *L. cinctus* Blackw.) from Shoa, Africa. 4 *g*. Variety from Lake Albert Nyanza, Africa.

PLATE XXVII.

Fig. 1. *Latrodectus hasseltii*, var. *indicus*; Kurrachee: p. 255. Dorsal view of female. 1 *a*. Integument of central dorsal posterior red band, showing absence of acanthoid spines. 1 *b*, 1 *c*, 1 *d*, 1 *e*. Varieties from the Loyalty Islands. 1 *f*. Integument of central dorsal posterior band, showing bristles set closer together than in var. *indicus*.

2. *Latrodectus mactans*; Mexico: p. 253. Dorsal view of female. 2 *a*. Integument of abdomen, showing fine bristles only.

3. *Latrodectus menavodi*; Madagascar: p. 255. Dorsal view of female. 3 *a*. Integument of abdomen, showing fine bristles of two lengths.

4. *Latrodectus curaçaviensis*; Santarem, Lower Amazons: p. 254. Dorsal view of female from Santarem. 4 *a*. Variety from Curaçoa, almost identical in coloration with other varieties from Santarem.

5. *Latrodectus katipo*; New Zealand p. 255. Dorsal view of female. 5 *a*. Ditto, variety. 5 *b*. Ditto, variety. 5 *c*. Ditto, variety. 5 *d*. Profile view, showing relative length of leg i. 5 *e*. Integument of abdomen, showing fine hairs only.

6. *Latrodectus hasseltii*: p. 255. Profile view, showing relative length of leg i.

7. *Latrodectus geometricus*; Cape Town: p. 252. 7 *a*, 7 *b*, 7 *c*, 7 *d*, 7 *e*. Dorsal view of females, varying in colour from almost white to almost entirely black, from Table Mountain.

3. Notes on the Painted Snipe (*Rostratula capensis*) and Pheasant-tailed Jaçaná (*Hydrophasianus chirurgus*). By FRANK FINN, B.A., F.Z.S., Deputy Superintendent of the Indian Museum, Calcutta.

[Received March 12, 1902.]

Few Waders are better known to sportsmen and to other observers of wild bird-life in India than these two beautiful species. But there is always something to be learnt from the close observation necessary to the successful retention of specimens in captivity; and as I have made a special study of examples of these two birds with a view to sending them to the Society's Gardens—in which I was fortunately successful[1]—I venture to record a few notes which I have been led to make concerning them.

[1] [Three Painted Snipes were received from Mr. Finn on January 1st, 1901, and nine Pheasant-tailed Jaçanás on January 11th, 1902 (see P. Z. S. 1902, vol. i. p. 51). —ED.]

I. *The Painted Snipe.*

This species, although not so abundantly brought into the Calcutta Provision Market as the true Snipes *Gallinago cœlestis* and *G. stenura*, is nevertheless commonly to be had during the winter, and I have kept many examples. They bear confinement well on the whole, but never become properly tame, although they will let themselves be caught more readily than most birds. This is no doubt largely due to the fact that they are in the habit of either crouching to avoid detection—their olive-green dorsal coloration, with yellow longitudinal stripes, making for protection—or of endeavouring to frighten off an otherwise unavoidable enemy by hissing and expanding their spotted wings. When only slightly alarmed they open the wings without spreading them; if still more persecuted, they expand the further wing and raise it; while, in desperation, they spread both wings and the tail, forming a most beautiful fan. Both sexes do this equally, and, so far as I can judge, make much the same sound, which is like that produced by plunging a hot iron into water. At the same time they crouch down close to the ground. I have seen them show off in this way to other birds—a Rail, a Ruff, and a Pitta, none of which were at all impressed by the display. I have, however, seen a Golden Plover (*Charadrius fulvus*) frightened thereby, although this species is bold and pugnacious with other birds.

I have no doubt that the natives who informed Hume that this was also the position assumed during courtship were correct in their statements, since in so many birds the so-called courting postures are merely those assumed on any excitement, as may be well seen in the Turkey and Muscovy Duck.

When at rest the Painted Snipe squats down with the breast on the ground and the tail up, the bill also pointed downwards. At such times the head has a smooth rounded appearance. When, however, the bird is moving about, there appear two superciliary ridges, which give the head a quite different expression and show off the magnificent dark eyes. There is also during movement an up-and-down motion of the hinder part of the body, similar to that observable in the Common Sandpiper (*Tringoides hypoleucus*), but slower.

This so-called Snipe appears never to bore for food, but it will search for it in water, or even sand, with a motion much like that of the Spoonbill. It eats grain—paddy and canary-seed—readily, the latter seeming to be best assimilated, although the former is more readily taken. It will also devour maggots, but appears not to care about worms. The flight is entirely Rail-like, and when the bird is skulking along to hide, the gait is also like that of a Rail. Like a Rail, also, the Painted Snipe swims readily, but this of course is not an important point, as the power of swimming is general among the Waders. The grain-eating habit is also common to the Ruff and Black-tailed Godwit among the family allies of *Rostratula*.

I once kept a young bird of this species, which I obtained when nearly full-fledged. It fed well on canary-seed and maggots, and I kept it till it was full-grown, but it showed no more tendency to become tame than an old bird.

I am rather astonished at Blyth's failure to keep this species alive, as I do not consider it hard to manage, except for its tendency to fly against netting and to abrade its bill by its futile attempts to escape. If kept in a cage with upright bars it is certain to hurt itself, but in a hutch with netted front, or a good-sized aviary, it will do well, and some have survived for a year at the Calcutta Zoological Gardens, though several succumbed after this on getting access to unsoaked grain.

II. *The Pheasant-tailed Jaçaná.*

This very beautiful and graceful wader has been a special favourite of mine ever since I began seriously to study it. It is one of the most numerously-captured species during the winter, but it is not by any means easy to keep in captivity. The difficulty lies in the fact that the birds' legs and feet must be kept damp in order that they may thrive, as otherwise the skin about their hocks cracks and dries, and they become lame.

I used to turn out the birds that did not seem to be doing well on the pond in the Museum grounds, generally with clipped wings, and several lived there for some time, remaining most of the time on masses of "kalmi" or water-convolvulus. Three males are still (February) there, two of which are full-winged, but seem to have no desire as yet to go away. When standing on the weeds, they are most difficult to see from the other side of the pond, which is about sixty yards across, but on the wing they are most conspicuous objects. In this respect they much resemble the Paddy-bird or Pond-Egret (*Ardeola grayi*), which has a similar plan of coloration, with a brown upper surface and concealed white wings. Both birds have a somewhat similar flight, and, were they insects, one would probably be said to mimic the other. No doubt, however, in both birds the coloration is merely protective. When in breeding-plumage both the Egret and the Jaçaná are easy to see, especially the latter, which is a very conspicuous object in the pied livery of the nuptial season, set off by the long black tail. A female on the tank last May had assumed nuptial plumage, as had one male, while two other males and a pair of young birds still remained in undress.

The old hen would only allow one male to remain near her, this being one of the winter-plumaged adults; the full-plumaged male was not allowed to approach, and even the favoured bird, although he often drew near her in a stooping attitude, which was the nearest approach to courtship I saw, was driven off if he got too near. The birds never made any display of their beautiful white black-bordered wings, which rather surprised me. I found that the birds were distinctly pugnacious about this time, observing

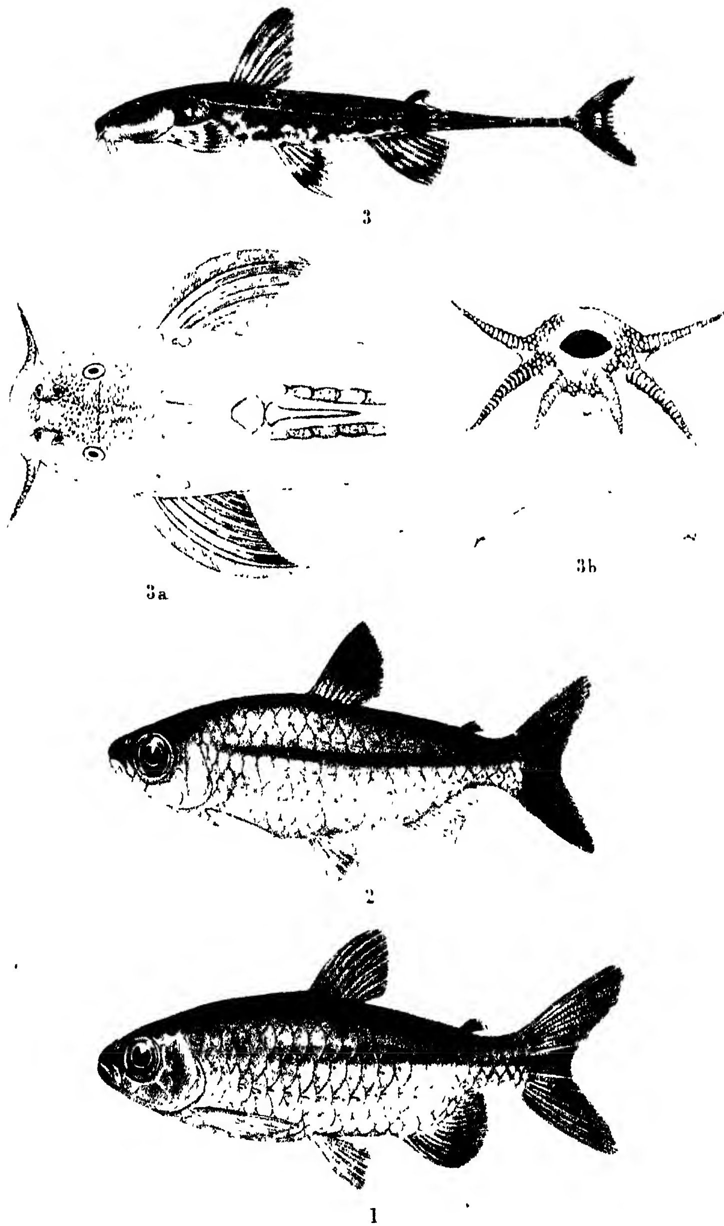
boundaries strictly and attacking strangers. In fighting, they seize with the beak and strike with both wings at once. The spur with which the carpal joint is armed is only represented by a small, movable, pointed tubercle in winter, and is evidently a seasonal growth like the horns of the deer. They swim gracefully, but slowly. Of many birds turned on the pond, only two were seen to dive in trying to get away when first let out. They swam only with their wings, which are remarkably powerful, very unlike those of the Rails. The feet are very weak in grasping-power, the hallux especially only flexing at the basal joint; in the Rails the last joint flexes strongly.

There is a good deal of variation in this species. I have seen one or two specimens with particularly stout strong bills, fine old females; some, irrespectively of age or sex, are glossed with purple on the brown upper surface at all times—all show the gloss when wetted. The eyes are usually brown in adults and yellow in the young; but I have seen two quite young birds with the dark iris, and many old ones, in adult winter plumage, retaining the yellow eye. Birds showing the iris in a state of change are curiously rare.

In watching the market for years, I never saw an adult retaining its summer plumage in winter; but one of my males on the pond, which has "stuck in the moult," to use a bird-fancier's expression, has never thoroughly changed into winter dress. From observation of another of these males, I believe the quills are cast at once.

This bird does not appear to fear Kites, nor do these offer to attack it, even when sickly; perhaps they fear its strong and armed wings. It is a bold species, caring little for other birds, and not timid with man after a few days' immunity on a pond; in a cage it is not so easily reconciled, and is apt to hurt its wings at the carpal point, much as Doves will frequently do when first caged. Almost the only food I have seen taken by the birds at liberty is small water-snails about the size of peas; in captivity they will take to paddy at once, and also eat canary-seed and maggots. The grain should always be soaked for them, and their legs frequently wetted when they are confined in a cage. They never seem to feel the heat in the open, remaining in the hot sun all day long without panting.

The males are certainly better protected than the females, the greater height of which exposes their white breasts when on the low kalmi weed; but no doubt in more lush vegetation the hens also would share in the protection which the coloration affords to this most interesting bird.



J. Smit del. et lith. Mintern Bros. imp.

1, 2 MICRALESTES STORMSI. 3 PHRACTURA LINDICA.

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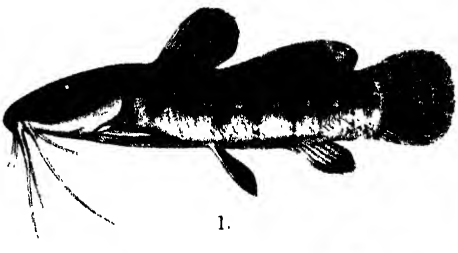

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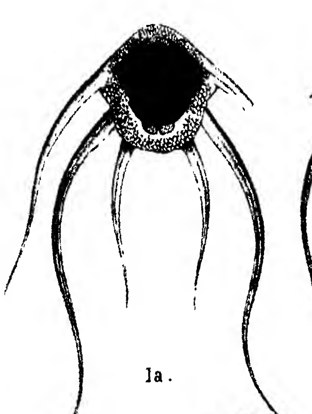

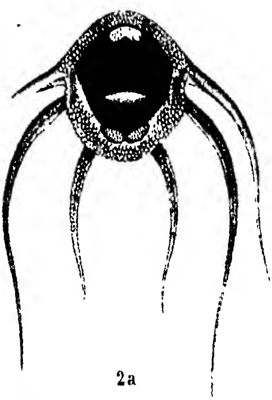

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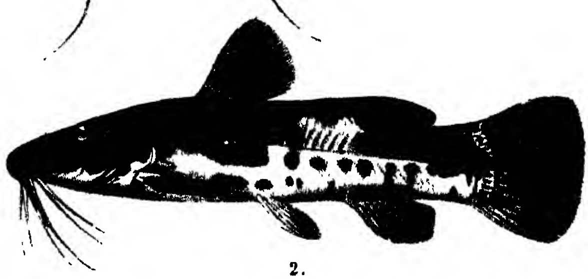
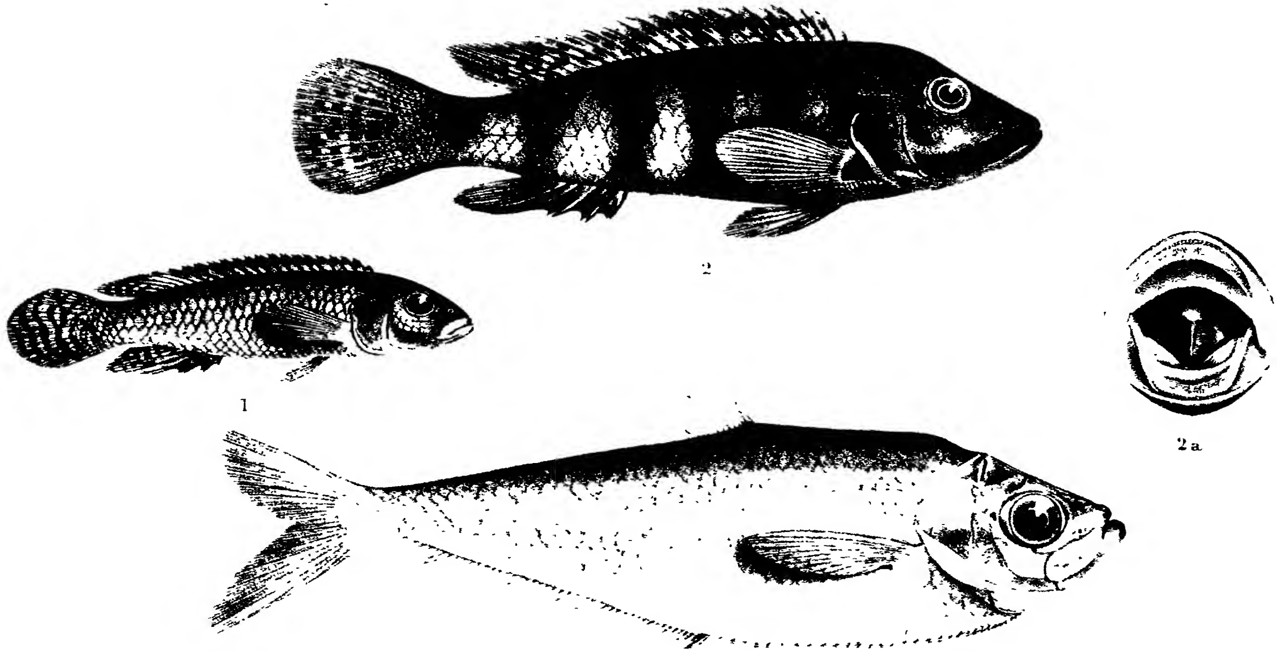


2.

J Smit del et lith. Mintern Bros imp

1 AUCHENOGLANIS PUNCTATUS. 2 AUCHENOGLANIS PULCHER.
3. AMPHILIUS BREVIS



P.J. Smit del. et lith.

Mintern Bros. imp.

[illegible] STORMS

[illegible]

4. Contributions to the Ichthyology of the Congo.—II. On a Collection of Fishes from the Lindi River. By G. A. Boulenger, F.R.S.

[Received March 17, 1902.]

(Plates XXVIII.–XXX.[1])

Among the material which has been most obligingly intrusted to me for study by the Director of the Royal Natural History Museum in Brussels there is a large and important collection of Fishes made by M. Maurice Storms, a cousin of the late Raymond Storms, so well known for his important contributions to palæichthyology, in the Lindi River, which flows into the Congo at the Stanley Falls. As the fauna of this river had not previously been explored, it is desirable to give a list of all the species represented in the collection, seven of which are new to science.

Mormyridæ.

1. Mormyrops deliciosus Leach.

2. Petrocephalus simus Sauv.

3. Marcusenius pulverulentus Blgr.

4. Stomatorhinus humilior Blgr.

5. Myomyrus macrodon Blgr.

6. Gnathonemus moorii Gthr.

7. Gnathonemus elephas Blgr.

8. Gnathonemus rhynchophorus Blgr.

Characinidæ.

9. Hydrocyon lineatus Blkr.

10. Bryconæthiops microstoma Gthr., var. boulengeri, Pellegr.

11. Alestes grandisquamis Blgr.

12. Micralestes humilis Blgr.

13. Micralestes altus Blgr.

14. Micralestes stormsi, sp. n. (Plate XXVIII. figs. 1 & 2.)

Depth of body 3½ times in total length, length of head 4 times. Head longer than deep, twice as long as broad; snout shorter than the eye, the diameter of which equals the interorbital width

[1] For explanation of the Plates, see p. 271.

and is contained $2\frac{2}{3}$ to 3 times in the length of the head; maxillary extending to below anterior border of eye; præmaxillary teeth 16, in two rows, the outer tricuspid, the inner quinquecuspid; mandibular teeth 8 in the outer row, tricuspid. Gill-rakers short, 12 or 13 on lower part of anterior arch. Dorsal II 8, originating above ventrals, at equal distance from the tip of the snout and the root of the caudal, $1\frac{1}{2}$ as deep as long and about $\frac{3}{4}$ the length of the head. Adipose fin 2 to 3 times as distant from the rayed dorsal as from the caudal. Anal III 15-16, deeper and with more convex border in the males than in the females. Pectoral longer than the ventral, $\frac{3}{4}$ or $\frac{4}{5}$ the length of the head. Caudal forked, with pointed lobes. Caudal peduncle as long as deep. Scales 22-24 $\frac{4\frac{1}{2}}{3\frac{1}{2}}$, 2 between lateral line and base of ventral. Brownish above, white beneath, with a silvery lateral band.

Total length 75 millim.

Numerous specimens.

15. Distichodus fasciolatus Blgr.

16. Distichodus sexfasciatus Blgr.

17. Nannocharax fasciatus Gthr.

18. Nannocharax elongatus Blgr.

19. Nannocharax tænia Blgr.

Cyprinidæ.

20. Labeo greenii Blgr.

21. Labeo parvus Blgr.

22. Barbus kessleri Stdr.

23. Barbus humeralis Blgr.

24. Barilius ubangensis Pellegr.

B. fasciolatus Blgr. is identical with this species. The fascicle of the *Bulletin du Muséum* containing Dr. Pellegrin's description was not received in London until March 3rd of this year, after my description had gone to press in the Ann. Mus. Congo, Zool. ii. p. 34 (March 1902).

25. Chelæthiops elongatus Blgr.

Siluridæ.

26. Clarias angolensis Stdr.

27. Clarias bythipogon Sauv.

28. Eutropius congolensis Leach.

29. Auchenoglanis punctatus, sp. n. (Plate XXIX. figs. 1, 1 *a*.)

Depth of body 5 times in total length, length of head 3 times. Head smooth, $1\frac{1}{3}$ as long as broad; snout pointed, half the length of the head; diameter of eye 6 times in the length of the head, hardly twice in the interocular width; width of mouth more than half that of the head; lips wide, papillose; posterior nostril cleft-like, a little nearer the eye than the end of the snout; præmaxillary teeth forming a short and narrow band, the mandibulars two rounded groups; maxillary barbel as long as the head, reaching the middle of the pectoral spine; outer mandibular barbel $1\frac{1}{3}$ the length of the head, inner $\frac{1}{2}$ the length of the head; gill-membranes forming an obtuse angle; occipital process small, as long as the eye, separated from the interneural shield, which is very small. Humeral process small, pointed. Dorsal I 7; spine smooth, $\frac{4}{5}$ the length of the head. Adipose fin 4 times as long as deep, nearly reaching the caudal, narrowly separated from the rayed dorsal. Pectoral spine half as long as the head, its inner edge strongly serrated. Ventral not reaching the anal. Latter with 10 rays, 7 of which are branched. Caudal rounded. Pale brownish, with seven indistinct darker bars, each accompanied by a vertical series of black dots; belly white; dorsal and caudal fins with transverse series of dark spots.

Total length 80 millim.

A single specimen.

Allied to *A. ubangensis* Blgr. Differing principally in the longer maxillary barbel.

30. Auchenoglanis pulcher, sp. n. (Plate XXIX. figs. 2, 2 *a*.)

Depth of body 5 to $5\frac{1}{2}$ times in total length, length of head 3 to $3\frac{1}{2}$ times. Head smooth, $1\frac{1}{2}$ as long as broad; snout obtusely pointed, half the length of the head; diameter of eye 7 to 9 times in length of head, twice to twice and a half in the interorbital width; width of mouth rather more than half that of the head; lips wide, papillose; posterior nostril cleft-like, a little nearer the eye than the end of the snout; præmaxillary teeth forming a reniform group, the mandibulars two rounded groups; maxillary barbel $\frac{2}{3}$ to $\frac{3}{4}$ the length of the head, not extending beyond the base of the pectoral; outer mandibular barbel nearly as long as the head, inner nearly half the length of the head; gill-membranes forming an acute angle; occipital process small, as long as the eye, separated from the interneural shield, which is very small. Humeral process small, pointed. Dorsal I 7; spine smooth, half the length of the head. Adipose fin 4 to 5 times as long as deep, twice to twice and a half as long as its distance from the rayed dorsal. Pectoral spine half as long as the head, its inner edge strongly serrated. Ventral not reaching the anal. Latter with 11 or 12 rays, 7 or 8 of which are branched. Caudal rounded. Caudal peduncle as long as deep. Yellowish, brown on the back, with transverse series of round black spots; a large black blotch

on each side below the dorsal fin; belly white; dorsal and caudal fins with round black spots.

Total length 100 millim.

Several specimens.

Distinguished from the preceding species and from *A. ubangensis* by the smaller eye; from the former by the shorter, from the latter by the longer maxillary barbel.

31. AMPHILIUS[1] BREVIS, sp. n. (Plate XXIX. fig. 3.)

Depth of body 6 to $6\frac{1}{2}$ times in total length, length of head $3\frac{2}{3}$ to $3\frac{1}{4}$ times. Head much depressed, a little longer than broad; snout broadly rounded, $\frac{1}{3}$ the length of the head; eye very small, 9 or 10 times in length of head, $2\frac{1}{2}$ or 3 times in interocular width; maxillary barbel $\frac{2}{3}$ or $\frac{3}{4}$ length of head, scarcely longer than the outer mandibular, inner mandibular about $\frac{1}{3}$ length of head. Dorsal I 6, equally distant from the end of the snout and the root of the caudal; adipose fin once and a half to twice as long as the rayed dorsal, $1\frac{1}{3}$ to $1\frac{1}{2}$ as long as its distance from the latter. Pectoral longer than the ventral, $\frac{2}{3}$ the length of the head. Anal II 6. Caudal feebly emarginate. Caudal peduncle as long as deep. Brown above, dotted with black; belly white; caudal peduncle blackish towards the base of the caudal; fins white, caudal with a large rhomboidal or cruciform black marking.

Total length 48 millim.

Two specimens.

This species is most nearly related to *A. platychir* Gthr., which differs, among other points, in having the dorsal fin nearer the end of the snout than the caudal, and the caudal peduncle longer than deep.

32. SYNODONTIS GRESHOFFI Schilth.

33. SYNODONTIS PLEUROPS Blgr.

34. SYNODONTIS DECORUS Blgr.

35. EUCHILICHTHYS ROYAUXI Blgr.

36. PHRACTURA LINDICA, sp. n. (Plate XXVIII. figs. 3, 3 *a*, 3 *b*.)

Depth of body $7\frac{1}{2}$ to 8 times in total length, length of head 5 to $5\frac{1}{2}$ times. Head $1\frac{1}{3}$ to $1\frac{2}{5}$ as long as broad, nearly smooth above, covered with papillose skin; snout half length of head, obtusely pointed, projecting but slightly beyond the mouth; space between the two nostrils at equal distance from the end of the snout and from the eye, or a little nearer the latter; eye superolateral, its diameter 6 to 7 times in length of head, twice in interocular width; barbels thick and papillose, annulate, maxillary $\frac{1}{2}$ length of head, outer mandibular $\frac{1}{3}$, inner mandibular $\frac{1}{4}$; occipital process narrow, 4 times as long as broad, narrowly separated

[1] *Amphilius* Gthr. 1864, = *Anoplopterus* Pfeff.

from the small interneural shield. Dorsal I 6, first ray longest, slightly longer than the head; second dorsal very small, originating above last rays of anal, its posterior rays adnate to the back through a transparent membrane. Anal II 7–8. Pectoral a little longer than head, reaching, or not quite reaching base of ventral; latter a little shorter, reaching anal; outer ray of pectoral and ventral much thickened. Caudal with crescentic notch. Caudal peduncle much depressed, $\frac{2}{7}$ to $\frac{1}{3}$ total length. 23 or 24 dorsal and 18 or 19 ventral scales, of which 8 or 9 are on the caudal peduncle, the last 5 united round the latter. Yellowish brown above, speckled with darker and with four more or less distinct broad dark cross-bands; fins whitish, with brown spots forming bars across the pectorals and ventrals.

Total length 82 millim.

Four specimens.

The genus *Phractura* Blgr. was represented by three species: *P. bovei* Perugia, from the Lower Congo, of which I have lately examined three specimens belonging to the Brussels Museum; *P. scaphirhynchura* Vaill., known from two specimens from the Alima, Upper Congo; and *P. ansorgii* Blgr., recently described in these 'Proceedings' from a single example discovered by Dr. Ansorge in Southern Nigeria. The four species now known may be distinguished by means of the following synopsis:—

I. Occipital process not reaching interneural shield; snout about half length of head.
  Head feebly rugose above, posterior nostril nearly as distant from the eye as the anterior from the end of the snout; diameter of eye 10 or 11 times in length of head, $2\frac{1}{2}$ or 3 times in interocular width; maxillary barbel $\frac{2}{3}$ length of head . . . 1. *P. bovei* Perugia.
  Head smooth above; posterior nostril nearly as distant from the eye as the anterior from the end of the snout; diameter of eye 6 or 7 times in length of head, twice in interocular width; maxillary barbel $\frac{1}{2}$ length of head . . . 2. *P. lindica* Blgr.
  Head rugose above, with strong ridges, posterior nostril very near the eye, the diameter of which is 7 times in length of head and $1\frac{2}{3}$ in interocular width; maxillary barbel $\frac{1}{2}$ length of head . . . . 3. *P. ansorgii* Blgr.
II. Occipital process in contact with interneural shield; snout more than half length of head; eye 7 times in length of head, $1\frac{1}{3}$ in interocular width; maxillary barbel $\frac{1}{4}$ length of head . . 4. *P. scaphirhynchura* Vaill.

CYPRINODONTIDÆ.

37. HAPLOCHILUS SINGA Blgr.

ANABANTIDÆ.

38. ANABAS MACULATUS Thomin.

Cichlidæ.

39. Hemichromis fasciatus Peters.

40. Pseudoplesiops squamiceps, sp. n. (Plate XXX. fig. 1.)

Depth of body $3\frac{1}{2}$ times in total length, length of head 3 times. Upper profile of head curved; snout a little longer than the diameter of the eye, which is contained $3\frac{1}{2}$ times in the length of the head and equals the interorbital width; mouth with broad, thick lips, extending to below anterior border of eye; 3 series of teeth in the upper jaw; occiput and sides of head with large scales; 2 or 3 series of scales on the cheek. 8 gill-rakers on lower part of anterior arch. Dorsal XVII 8; spines subequal from the sixth, barely one third length of head; longest soft rays two thirds length of head. Anal III 6; third spine longer than dorsals, two fifths length of head; soft rays like dorsals. Pectoral about two thirds the length of the head. Ventral about the same length, not reaching the vent. Caudal rounded. Caudal peduncle as long as deep. Scales cycloid, 29 in a longitudinal, 13 or 14 in a transverse series; upper lateral line on 8 or 9 scales, forming an interrupted series, lower on 3 or 4. Pale brownish above, white beneath; a dark horizontal streak on each side of the head, behind the eye; soft dorsal, anal, and caudal fins with numerous transverse series of small dark spots.

Total length 65 millim.

Two specimens.

Distinguished from *P. nudiceps* by the scales on the head, the shorter dorsal spines, and the interrupted lateral lines.

41. Tilapia stormsi, sp. n. (Plate XXX. figs. 2, 2 *a*.)

Teeth in 4 to 7 series, outer deeply notched, inner much smaller and tricuspid; 36 to 60 teeth in the outer præmaxillary series. Depth of body equal to length of head, 3 to $3\frac{1}{4}$ times in total length. Snout rather pointed, with straight or slightly convex upper profile, $1\frac{1}{3}$ to $1\frac{2}{3}$ the diameter of the eye, which is contained 4 to $4\frac{1}{2}$ times in the length of the head and equals the interorbital width; width of mouth about $\frac{2}{3}$ that of the head; maxillary extending to between nostril and eye; 3 or 4 series of scales on the cheek; large scales on the opercle. Gill-rakers short, some anvil-shaped, 11 or 12 on lower part of anterior arch. Dorsal XVI–XVII 9; last spine longest, about $\frac{2}{5}$ the length of the head, about $\frac{2}{3}$ the longest soft rays. Pectoral rounded, about $\frac{2}{3}$ the length of the head, widely separated from the anal. Ventral not reaching the vent. Anal III 7; third spine about $\frac{1}{3}$ the length of the head. Caudal rounded. Caudal peduncle as long as deep. Scales with strong marginal denticulation, 30–31 $\frac{2\frac{1}{2}-3}{16-17}$; lateral line $\frac{21-23}{6-11}$; scales on the occiput and nape very small. Olive-brown above, some of the scales black at the base; 5 or 6 more or less indistinct dark cross-bands; a blackish

opercular spot; dorsal and caudal fins with small dark spots; a fine blackish edge to the caudal above and beneath.

Total length 102 millim.

Five specimens.

Allied to *T. fasciata* Perugia.

Appendix.

In a series of specimens from other parts of the Congo State, belonging also to the Brussels Museum, the representative of a new species of a marine Clupeid genus was found, which I have great pleasure in naming after my friend and colleague M. L. Dollo.

Pristigaster dolloi, sp. n. (Plate XXX. fig. 3.)

Closely allied to *P. cayanus* Cuv., but abdominal profile much less convex. Depth of body 3 times in total length, length of head 4 times. Eye longer than the snout, shorter than the post-ocular part of the head; maxillary extending to below the centre of the eye. Gill-rakers long, 25 on lower part of anterior arch. Dorsal 15, equally distant from the end of the snout and the root of the caudal. Anal 46, originating below the middle of the dorsal. Pectoral nearly as long as the head. Caudal deeply forked. Caudal peduncle as long as deep. About 40 scales in a longitudinal series. Ventral serration formed of 32 spinose scutes. Uniform silvery.

Total length 120 millim.

A single specimen from Banana.

EXPLANATION OF THE PLATES.

Plate XXVIII.

Fig. 1. ***Micralestes stormsi***, male, p. 265.
2. „ „ female.
3. ***Phractura lindica***, p. 268.
3 *a*. „ „ Upper view of head and anterior part of body, × 2.
3 *b*. „ „ Lower view of head, × 3.

Plate XXIX.

Fig. 1. ***Auchenoglanis punctatus***, p. 267.
1 *a*. „ „ Open mouth, × 2.
2. „ ***pulcher***, p. 267.
2 *a*. „ „ Open mouth, × 2.
3. ***Amphilius brevis***, p. 268.

Plate XXX.

Fig. 1. ***Pseudoplesiops squamiceps***, p. 270.
2. ***Tilapia stormsi***, p. 270.
2 *a*. „ „ Open mouth, × 2.
3. ***Pristigaster dolloi***, p. 271.

5. Field-Notes upon some of the larger Mammals of Patagonia, made between September 1900 and June 1901. By Hesketh Prichard, F.Z.S.

[Received March 13, 1902.]

1. The Huemul. (*Xenelaphus bisulcus.*)

(*Huemul* of the Argentines and Chilians; *Cierro* of the Gauchos of Southern Patagonia; *Shoan* of the Tehuelches.)

In the neighbourhood of Lake Buenos Aires this beautiful deer first came under my observation. On the south side of the valley of the river De los Antiguos I saw a buck (which I shot), two does and a pricket. I was informed by my Gaucho, Humphrey Jones, that the Huemul is found in the woods as far north as the Welsh Colony of the 16th October about lat. 43°, and that on the south its range extends to the Straits of Magellan. Its present habitat may be broadly said to extend as far east as the foothills of the Andes. Dr. F. P. Moreno states that the *Xenelaphus bisulcus* has been seen in the hills in the vicinity of Port Desire on the Atlantic coast; I do not, however, think it is any longer to be found there. So far as my personal observations go, I never came across a specimen farther east than a couple of miles from the shores of Lake Buenos Aires upon its north-eastern side. The Indians say that this animal was at one time more numerous in this region.

During the summer these deer leave the lower grounds where the mosquitoes trouble them, and travel up to the snow-line of the Cordillera and even beyond it. At this season I never observed a large herd; but in the winter, Mr. Cattle, a pioneer living near Lake Argentino, informed me that a numerous herd, over 100 strong, had visited the lake.

The Huemuls are in the habit of wandering outside the forests in the morning and forenoon, but in the afternoon they generally retire to their shelter, where they often lie down. I have found these animals in the dense forests upon the slopes of the Cordillera which border the lakes. They are excellent swimmers, and cross the broad arms of Lake Argentino without hesitation.

In December the Huemuls which I shot were shedding their winter coat, and I noticed that the bucks were further advanced in this matter than the does. There were a few scraps of velvet clinging to the horns of one of the bucks which I shot on the 17th of December.

The best head that I secured carried 5 points. Mr. Von Plaaten Hallermund, of the Argentine Boundary Commission, told me that he had seen a Huemul's head carrying 8 points; this was in the neighbourhood of Lake San Martin. One of my peones, Bernardo Hahansen, who had penetrated into the same district, said he also had seen an 8-pointer. Mr. Cattle and his companions shot two bucks, both of which were 4-pointers.

Save for the attacks of the Pumas, *Xenelaphus bisulcus* lives pretty well undisturbed in its fastnesses. The Indians do not hunt the Huemul, as in the forest-land their horses and *boleadores* are comparatively useless. They do occasionally kill a few, which may have strayed to the foothills and to the shores of the lakes.

These deer, which know little of man, are in general very confiding. Near the Colony of the 16th October, Jones told me that they had become very wary and difficult of access, as was to be expected in a region where they are constantly hunted. In the unpenetrated districts the buck is very courageous in the rutting-season, and has been known to make some show of attacking man. On open ground, according to my experience, they showed wonderfully little timidity, and would wait the approach of man, but inside the forests they invariably dashed away on catching a glimpse of one of our party.

When it has observed something unusual in its surroundings, the Huemul will remain watching and without moving for a great space of time. On one occasion, I saw near Lake Argentino a buck and doe about a quarter of a mile away. I lay under a bush, watching some wild cattle, and the Huemuls stood and watched me for nearly an hour. They were about 10 yards apart. On my returning to the same spot in the evening, I found them still watching my horse, which I had tied up in their view.

In one or two instances, when I fired at a Huemul, the others of the herd have run towards the noise. Once this occurred when I was in full sight of the animals. If, however, you have a dog with you, they will immediately take to flight.

Musters, in his 'Travels in Patagonia,' mentions a "red" deer. Of this I could find no trace; so that I conclude that he probably referred to *Xenelaphus bisulcus* under this name.

2. The Puma. (*Felis concolor puma.*)

(*Lion* of the English settlers; *Leon* of the Argentines, Chilians, and Gauchos; *Gol* of the Tehuelches.)

The distribution of *Felis concolor puma* extends over the entire country of Patagonia. It is to be found in the Cordillera as on the pampas. I came upon tracks of this animal at the end of the north-west arm of Lake Argentino, about long. 73° 14', and I also saw a Puma at the south-western extremity of that lake. Evidence of their existence accompanied the whole itinerary of the expedition throughout the entire route it covered. The number of Pumas in Patagonia is very great, more so than any traveller has as yet given any idea of. Two pioneers killed 73 in one winter near Lake Argentino. Near San Julian immense numbers are yearly destroyed, but now, owing to the advent of settlers, their numbers are decreasing. At Bahia Camerones, on the farm of Mr. Greenshields, 14 Pumas were killed during the winter of 1900.

A female killed near Santa Cruz measured 6 feet 10 inches; and a male killed near Lake Argentino, 8 feet 1 inch.

In strong contradistinction to the habit of *Felis onca*, *Felis concolor puma*, when hunting, kills a number of animals from a flock or herd. To only one of these kills, however, does it return, and it always makes some pretence of burying the victim singled out for its meal, throwing up upon the body in many cases merely a small bunch of thorns. This habit of the Puma is frequently taken advantage of by the shepherds, who poison the chosen carcase. The Puma, in ninety cases out of a hundred, makes its first meal upon the entrails of the victim, or upon the inside of the thigh by the groin. Another point in connection with the predatory habits of the Puma is the fact that it will travel a long distance, even as much as ten or twelve miles, after killing.

Its method of attack, judging from an examination of its kills, appears to be to spring upon the shoulders of its quarry and to break the neck. The destruction wrought by Pumas among flocks of sheep is immense. One Puma is said to have killed from a single flock upwards of 100, its total for a night amounting to 14. Cases are reported of Pumas having attacked horses; and sometimes a herd of cows, with their calves, take up the trail of a Puma with a great deal of lowing, but do not follow it far. *Felis concolor puma* usually selects a tempestuous night for its depredations upon the herds. Authentic instances of their having attacked man are few. Dr. F. P. Moreno tells me that on the bank of the River Leona, not far from Lake Viedma, he was attacked by a Puma. He was walking, wrapped up in a Guanaco skin *capa*, and he fancies the animal mistook him for a Guanaco. The Puma was killed by his companions, and was found to be in milk. Its cubs, however, were not discovered. Mr. Arenberg, of the Argentine Boundary Commission, was also attacked by one of these animals in the neighbourhood of Lake Buenos Aires. I have no details of the occurrence beyond the fact that he was wounded in the face. These two instances must be regarded as exceptional, for the Puma is ordinarily a very cowardly animal, and many are killed yearly with the *bolas* or lasso.

The Puma can easily be galloped down, as it rarely runs more than 300 yards or a quarter of a mile when pursued on horseback. It invariably stands at bay with its back to a bush or rock.

Darwin writes that "the Puma is a very silent animal, uttering no cry even when wounded, and only rarely during the breeding-season." In the forests upon the slopes of Mount Buenos Aires near Lake Argentino, one moonlight night, two Pumas circled round our camp, and for upwards of an hour kept uttering their peculiar cry. On no other occasion during our marches, although Pumas often stampeded the horses and left plain tracks of their presence close to the camp, did I hear them break silence.

3. Pearson's Puma. (*Felis concolor pearsoni.*)

On my return from Patagonia, I brought with me a skin of a Puma, which seemed to me to differ in some essential respects

from any known species. Mr. J. G. Millais, on examining the skin, agreed with me, and pointed out that it possessed several characteristics which do not occur in *Felis concolor puma.* I took the skin to the Natural History Museum, where Mr. Oldfield Thomas came to the conclusion that the animal was a sub-species of *Felis concolor puma*, and named it *Felis concolor pearsoni.*

The chief points of difference between *Felis concolor puma* and *Felis concolor pearsoni* are as follows:—The very different general colour of *Felis concolor pearsoni*, being reddish fawn instead of silver-grey; the proportionately very short tail; light instead of dark colour on the backs of the ears, which are, moreover, more sharply pointed in the case of *Felis concolor pearsoni*; and the absence of dark markings round the digital pads.

Several Gauchos, settlers, and Indians informed me that there were two kinds of Puma in Patagonia, one being very common, grey in colour, and very cowardly. The other they described as rare, much fiercer, of a reddish colour, and somewhat smaller than the grey common species. Among the 73 Pumas killed by the English pioneers near Lake Argentino, one, Mr. Cattle told me, differed very much from the ordinary Puma, and, judging from the description he gave of it, I have no hesitation in concluding that it was a specimen of *Felis concolor pearsoni.*

4. The Guanaco. (*Lama huanachus.*)

(*Huanaco* of settlers, Argentines, and Chilians; *Rou* of Tehuelches.)

During the whole course of our travels in Patagonia (save when in the forests) a day rarely passed without our seeing Guanacos. They may be met within a few hours' ride of any settlement. The range of the Guanaco extends all over the plains of Patagonia. In my experience they were most numerous in the Cañadon Davis, in the neighbourhood of Bahia Camerones, and on the high basaltic tablelands to the south of Lake Buenos Aires. At the base of the Cordillera, and in some of the river-valleys under the edge of the mountains, the range of the Guanaco crosses that of the Huemul. I do not think, however, that the Guanaco ever enters the forest: although I have seen them in the open patches amongst the lower wooded parts of the Cordillera. As the seasons change they move from lower to higher ground, but these migrations are limited; and a white Guanaco has been observed year after year in the same neighbourhood. During the time I spent at Lake Argentino—from 1st February to 15th May—I saw but few of these animals, for at that season all the herds migrate to the high pampa. A herd 300 or 400 strong inhabited the higher plateaus of Mount Frias.

FitzRoy, in his "Voyages of the 'Adventure' and the 'Beagle,'" writes:—

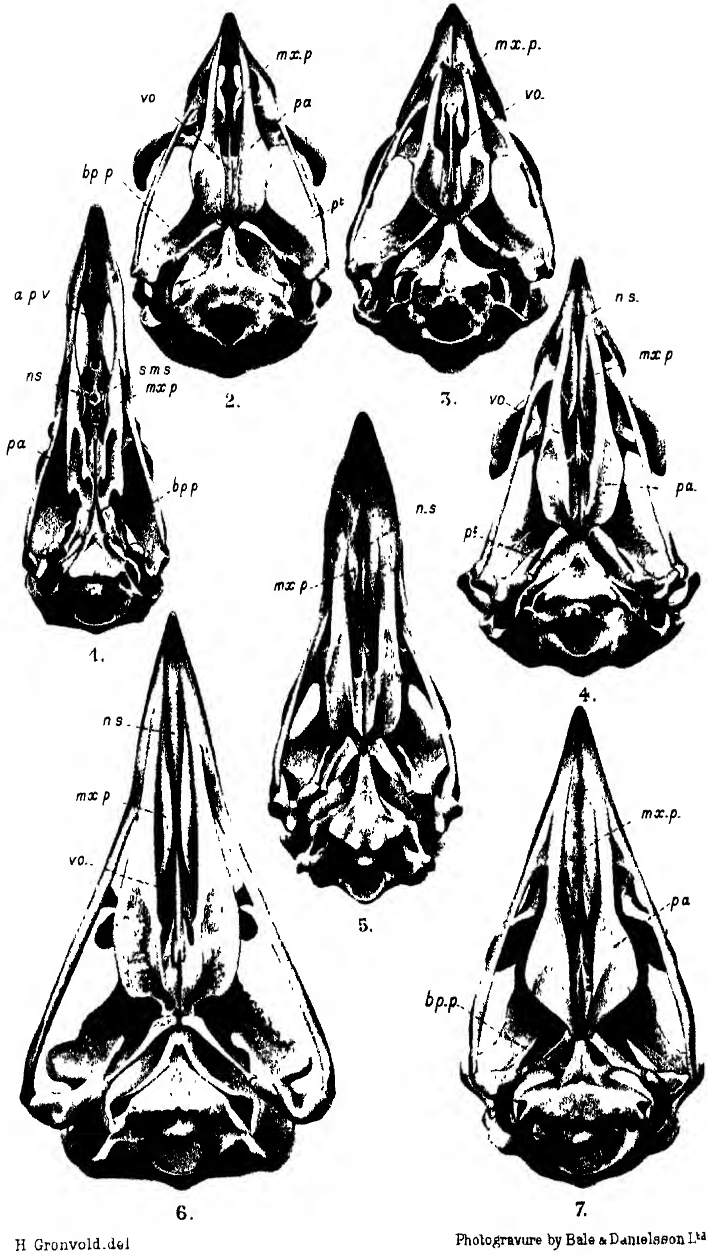
"Do the Guanacos approach the river to drink when they are

dying? or are the bones and remains of animals eaten by lions or by Indians? or are they washed together by floods? Certain it is that they are remarkably numerous near the banks of the river (Santa Cruz), but not so elsewhere."

It is true that, although one comes upon skeletons of these animals upon the pampas, they are not crowded together as they are in the cañadones or by the lakes near water. At the edge of a lagoon at the eastern end of Mystery Plain a great number of skeletons were to be seen. They extended in a wide track down the hillside and to the edge of the water. At Lake Viedma the margins of the lake, near the outflow of the River Leona, were covered with their skins and bones. The meaning of this I gathered from Mr. Ernest Cattle. He told me that in the winter of 1899 enormous numbers of Guanaco sought the Lake Argentino, and died of starvation upon its shores. In the severities of winter they seek drinking-places where there are large masses of water likely to be unfrozen. The few last winters in Patagonia have been so severe as to work great havoc among the herds of Guanaco.

At nightfall Guanacos gather into close order, a large herd collecting in a small radius. They seem to choose open spaces in which to pass the hours of darkness. In moments of danger also they pack together densely. At the sound of a shot, the outlying members of a herd will close up and sway their long necks almost to the ground in unison. I see that Darwin says that Guanaco are "generally very wild and wary." In places where they are hunted by the Indians this is no doubt the case, but on this point no law can be laid down. In some districts the Guanaco is very difficult of approach: in others extremely easy. Their instinct of curiosity is very largely developed. During our wanderings I studied the habits of the Guanaco with ever increasing interest. In cold weather they become extraordinarily tame, and will permit a man to walk among them as a shepherd walks among his sheep.

The young are brought forth in the months of October, November, and the early part of December. In Southern Patagonia some are born as late as the end of December. During the period of copulation the bucks fight a good deal. I never shot an old buck which was not seamed and scarred with the marks of these contests. When fighting they give vent to loud squeals of rage; they kick with their fore feet and bite savagely, mostly at the neck of the antagonist. The marks of these bites are often deep and long. The skin of the neck is very thick. As has been noted before, the Guanacos drop all their dung in one spot, and near these spots their wallows are ordinarily to be found. I saw an old buck spend a long time over his toilet while his wives looked on and waited. He would pass nearly half an hour on his back with his legs in the air, at intervals standing up to neigh, and then rolling again.



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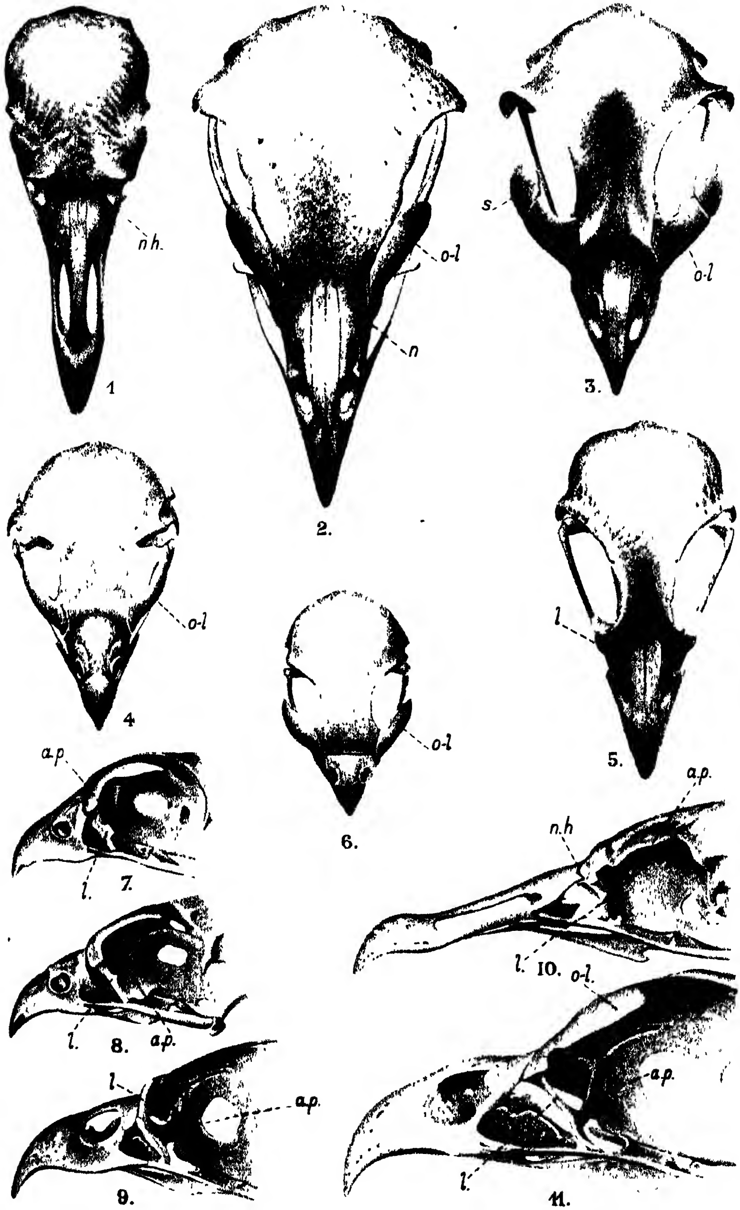
Photogravure by Bale & Danielsson Ltd

OSTEOLOGY OF THE FALCONIFORMES.



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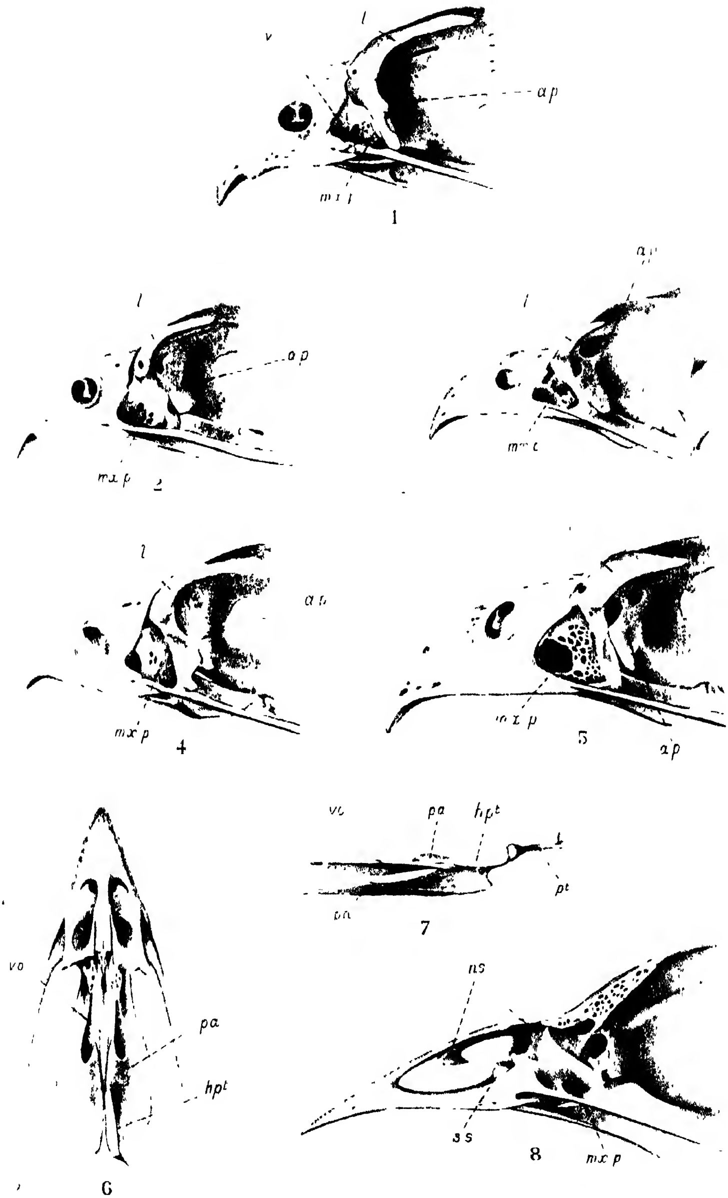
OSTEOLOGY OF THE FALCONIFORMES.



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OSTEOLOGY OF THE FALCONIFORMES

5. Patagonian Cavy. (*Dolichotis patagonica.*)

(Called "*Cavy*" or "*Hare*" indiscriminately by the English settlers; *Liebre* by the Chilians and Argentines; *Paahi* by the Tehuelches.)

The River Deseado forms the southern limit of the distribution of the Patagonian Cavy. In 1833, Darwin writes, concerning the Cavy: "They are found as far north as the Sierra Tapalguen (lat. 37° 30′), and their southern limit is between Port Desire and San Julian, where there is no change in the nature of the country." So far as my experience goes, I never observed a Cavy after 23rd October, upon which day I counted fourteen upon the pampa between Lake Musters and the settlement of Colohaupi. The residents at Colohaupi informed me that that place formed the southern limit of distribution of the Cavy. It is of course impossible to lay down an exact line, but I think I am safe in saying that the range of the Cavy does not extend south of the 46th parallel. This limit is the more remarkable inasmuch as the country south of lat. 48° does not in any way materially differ from that over which the Cavy is commonly to be met with. It is upon patches of dry mud that these animals are most often to be observed.

6. Little Armadillo. (*Dasypus minutus.*)

(*Pichy* of the Chilians and Argentines; *Ano* of the Tehuelches.)

This Armadillo is never found south of the River Santa Cruz. During the four months I spent south of that river I did not see one, but when, for three days, we crossed to the north bank, we met with four and killed one. *Dasypus minutus* is very common in the vicinity of the Bahia Camerones. I saw no specimen in the forests of the Andes, but near Lake Buenos Aires and Lago Viedma we found them at the foothills.

6. Contributions to the Osteology of Birds. Part V. *Falconiformes*[1]. By W. P. Pycraft, F.Z.S., A.L.S.

[Received March 4, 1902.]

(Plates XXXI.–XXXIII.[2] & text-figures 33–37.)

Contents.

i. Introductory Remarks.

The anatomy of the Falconiformes presents many characters in

[1] For Part IV. see P. Z. S. 1899, p. 1018.
[2] For explanation of the Plates, see p. 319.

common with certain of the Grues on the one hand, and of the Steganopodes and Herodiones on the other.

It will be the aim of the present paper to supplement the evidence of these affinities which has been so far collected, by a careful study of the Osteology of the Falconiformes,- a study which shall embrace comparisons of the skeletons of the forms not now regarded as allies of this group. By these means it may be possible to arrive at more definite conclusions concerning the probable inter-relationship of the undoubtedly allied forms, and of their phylogeny.

ii. The Skull of the Adult.

It seems to be impossible to draw up, in concise terms, any definition which shall serve us to readily distinguish the skull of the Falconiformes from any skull of what we are agreed to regard as the near allies of this group. This is due partly to the fact that the group contains some very aberrant forms with peculiar skulls, and partly to the fact that the characters upon which we are wont to rely for taxonomic purposes present us with many grades of perfection even amongst the smaller divisions of the group. Thus, the palate affords a series of gradations between complete desmognathism and complete schizognathism; basipterygoid processes may be very well developed or completely absent; the lachrymal may be free or fixed; the nares may be pervious or impervious; and so on.

The best that we can do is to say that no indirectly desmognathous Falconiform skull owes this form of desmognathism to the intervention of the vomer alone—as in the Cariamidæ. Again, no indirectly desmognathous Falconiform skull combines this form of desmognathism with a large vomer and a large anterior palatal vacuity. No Falconiform skull has supra-orbital grooves, or has the palatines fused in the middle line posteriorly. Finally, all the skulls of this Order have an ossified orbito-sphenoid.

The resemblances which the skull of the Falconiformes presents, through certain of its members, to the Steganopodes, Grues, and Striges will be pointed out and discussed in the following remarks.

The Occipital Region.

The plane of the occipital foramen varies, from an oblique angle to one almost parallel with the long axis of the skull. The forms in which the plane is almost horizontal are those which represent the higher types—the Eagles, Buzzards, and Falcons. The foramen in these forms thus looks downwards, instead of downwards and backwards.

In the Falcons, Buzzards, and Cathartæ there is a prominent cerebellar dome. This is less well-marked in the Vultures and Eagles, and in *Serpentarius*.

The *supra-foraminal ridge* is fairly well-marked in every

member of the group. It is continued downwards on either side to form the inner border of the processus alæ exoccipitalis inferior (paroccipital process, *auct.*).

The *lambdoidal ridge* is always single and has an undulating outline. It is continued outwards for some considerable distance, when it suddenly bifurcates, one branch running directly outwards and forwards to terminate at the superior angle of the exoccipital wing, at its junction with the squamosal process; and one directly downwards and outwards to lose itself in the free border of the exoccipital wing near its middle. In *Serpentarius*, *Polyboroides*, and the Vultures the upper and outer branch is barely perceptible or wanting. In Cathartæ there is a deep notch between the bifurcation, so that it appears, at first sight, to be wanting. We may probably regard this as the more primitive form, since the filling-in of this notch seems to have been to increase and perfect the tympanic aperture. Beneath the lambdoidal ridge, and on either side of the cerebellar prominence, lies a well-marked depression, the supra-occipital fossæ. The latter appear to be best developed in the Falcons. In the Cathartæ they take the form of wide channels.

The exoccipital wing is continued downwards into the *processus alæ exoccipitalis inferior* of Suschkin (paroccipital process, *auct.*). These will be found most strongly developed in the Cathartæ.

The exoccipital wings are much more developed in the Striges, where the upper and outer portion of the wing is developed on either side into a prominent, outstanding flabellum.

The cranial roof (Pl. XXXII.).—The cranial roof is never marked by supra-orbital grooves.

In *Serpentarius* (Pl. XXXII. fig. 2) the interorbital region is widened by long, horizontal, backwardly-directed lachrymal processes, the inner borders of which are closely applied to the frontal, but do not fuse therewith. In the Cathartæ (Pl. XXXII. fig. 1) there would appear to have been similar processes, but these have now fused completely with the frontal, a row of foramina only indicating their line of junction.

In the Accipitres (Pl. XXXII. fig. 3) these horizontal processes are free, and project on either side of the head, above the orbits. In the Buteonidæ there is a small free plate of bone attached by ligament to the end of the horizontal process—the superciliary plate. This plate is probably a remnant of the supra-orbital chain of ossicles such as occurs in some Palæognathæ, e. g. *Tinamus*, *Struthio*, and in *Psophia* among the Neognathæ. Both the horizontal process and the superciliary plate have undergone great reduction in the Vultures, *Gypohierax* alone retaining a small remnant of the accessory plate. This same reduction of the horizontal process is also a marked feature in *Polyboroides*, wherein it is almost suppressed; the descending process of the lachrymal, it may be mentioned in passing, is very long and slender. The lachrymal of *Pandion* has undergone still further degeneration, having fused completely with the frontals and

antorbital plate (prefrontal). The horizontal process is practically suppressed.

The fronto-parietal region in *Gypohierax*, *Aquila*, *Falco*, *Polyborus*, and *Milvus*, the parietal only in *Polyboroides*, *Buteo*, and *Haliaetus*, is marked by a shallow median groove. This groove is more or less traceable in all the Accipitres save the Cathartæ and *Serpentarius*. It is especially noticeable in the forms just enumerated. In the Cathartæ the roof of the skull presents an evenly rounded surface. The width across the skull at the fronto-parietal region in no case approaches that of some Owls, e. g. *Bubo*, owing to the smaller size of the postorbital processes.

The fusion of the nasals with the frontals is complete, and leaves no trace of the line of junction.

The Base of the Skull.

The basitemporal plate in *Serpentarius* only is visibly thickened by pneumatic tissue. In the remaining members of this group it is a thin triangular plate with a slightly concave ventral surface. Posteriorly it is bounded, in the middle line, by a more or less well-marked precondylar fossa. It extends outwards on either side as a wing-like plate to join the inferior wing of the exoccipital process, in *Serpentarius*, Eagles, Buzzards, Falcons, and Vultures, for instance. But in the Osprey this junction with the exoccipital - completing the mouth of the tympanic cavity below— is formed only by a thin bar of bone. In certain Vultures and in the Cathartæ the hinder angles of this plate appear to terminate in a pair of prominent mammillary processes. They are the dominant features of this region of the plate, and by their great size have come to lie behind the actual posterior angles. The two sides of this triangular plate may have sharply defined free edges, *e. g.* in *Aquila*, in which case the Eustachian channels are open grooves; or they may be partly fused with ossified connective tissue forming the anterior wall of the recessus tympanicus anterior, when the grooves are partly closed, *e. g.* *Serpentarius*, *Haliaëtus*, *Buteo*; or they may fuse throughout with the inferior border of the wall forming the above-mentioned recess, leaving only a small Eustachian aperture at the apex of the triangle, as in the Cathartæ and *Polyboroides*, for instance. In the Cathartæ the parasphenoidal rostrum immediately above this aperture is deeply excavated. This is especially marked in *Sarcorhamphus*.

The parasphenoidal rostrum may or may not bear basipterygoid processes. These are largest in *Serpentarius*, where they lie at the base of the rostrum. In the Cathartæ they may be either short and broad, as in *Catharistes* and *Gypagus*, or very slender and seated further forward on the rostrum, as in *Pseudogryphus* and *Sarcorhamphus* (Condor). This greater slenderness evidently marks the first stages in their decay. In a skull of *Sarcorhamphus*

in the collection of the British Museum the left process is smaller than the right, and both almost fail of their purpose, not only in this species but throughout the genus. They present within the Order every degree of degeneration, from the prominent pillars of *Serpentarius* to the most minute prickles.

Traces of the anterior basicranial fontanelle are often present.

The Lateral Surface of the Cranium. (Plate XXXIII. figs. 1–8.)

The *tympanic cavity* attains its greatest size in the Falcons. It may be studied in its more primitive form in such examples as *Polyboroides*, *Pandion*, *Pernis*, and the Vultures. The lateral occipital wings which bound this cavity behind in *Polyboroides* are but feebly developed. The free border, on either side, terminates in a blunt and low prominence behind and slightly above the level of the *processus zygomaticus*, and marks at the same time the lower and hindmost extent of the temporal fossa. In *Pandion* the free border of this wing, which is still feebly developed, slopes obliquely backwards and upwards to the level of the processus articularis squamosum, then turns sharply forwards to terminate in the process itself. *Pernis* resembles *Pandion* in this respect, but neither the backward slope nor the forward angle is so marked. In *Serpentarius* and the Vultures, e. g. *Neophron*, *Gypohierax*, and *Gypaetus*, the free edge of this wing is of greater extent, and projects as a slightly raised ridge beyond the zygomatic process. [In *Gyps* the form of the lateral occipital wing is drawn backwards and downwards to terminate in a prominent processus alæ exoccipitalis inferior (paroccipital process), and thus in this respect differs from *Neophron*, where the wing is more feebly developed and slopes from before backwards and upwards.] In *Buteo* the ridge lateral of the zygomatic process is much more prominent. In *Haliaetus* and *Aquila* it has increased still more. In the Falcons it forms a thin laminate plate, rising upwards to the level of the base of the zygomatic process of the squamosal, the free edge of which is turned forwards. In the development of this portion of the exoccipital it bears a strong resemblance to the Striges, e. g. *Bubo*.

The roof of this cavity is formed by the under surface of the *processus zygomaticus squamosi*. Its floor, in part by the lateral occipital wing, and in part by the ossification of tissue extending between this wing and the external angles of the basitemporal plate. In front it is bounded by the quadrate.

Within this cavity, in the dried skull, are two large apertures which may be considered separately. The first lies near the roof of the cavity and separates the squamosal and otic articular surfaces of the quadrate. The aperture leads upwards and backwards, so as to form a space between the anterior vertical and horizontal canals of the internal ear and the lateral occipital wing. This is the *recessus tympanicus superior*—the temporal recess of my earlier papers.

The second and lower aperture is divided from the first by the

articular surface for the otic head of the quadrate. Within it lie several foramina and the mouths of two pneumatic cavities. The foramina are the foramen ovale and the foramen rotundum, the foramen for the 7th nerve, and the foramina of the sinus petrosus. The pneumatic apertures are, as already stated, two in number. The first, and largest, opens into the mouth of the tympanic cavity at its antero-ventral angle. It may be traced inwards, and forwards, as a tubular recess leading into the parasphenoidal rostrum, terminating in the pituitary region. The anterior wall of this recess—the *recessus tympani anterior*—is formed in its larger exterior portion, as is shown by Suschkin [1], by ossification of connective tissue extending in the young skull between the alisphenoid above and the basisphenoid below. When the Eustachian grooves are closed, they form two additional and much smaller apertures, opening one on either side, into the tympanic cavity, below the mouth of this anterior tympanic recess. The second of these apertures is that of the posterior tympanic recess. It is very small and not easily seen. If carefully looked for, it will be found as a small hole, lying caudad of the foramen ovale and foramen rotunda. It leads into a small pneumatic cavity lying below the horizontal semicircular canal, and between this and the inferior border of the lateral occipital wing.

The separation of the squamosal and otic articular surfaces for the quadrate by the aperture of the superior tympanic recess is a point of some interest. In the Palæognathæ the recessus tympani superior is represented by a shallow cavity, lying *behind* the articulation for the head of the quadrate. The roof of the cavity is pierced by numerous small pneumatic apertures leading from a mass of diploë lying between, and above, the horizontal semicircular canal and the brain case. The external wall of this diploid tissue is formed by the parietal and lateral occipital bones. In some Dinornithidæ there is a small aperture connected with this mass of pneumatic tissue lying in *front* of the articulation for the quadrate. In the Neognathæ the aperture of the superior tympanic recess lies—in Steganopodes, Tubinares, and Sphenisci, for instance—in front of the quadrate articular surface. But in the Accipitres and Striges, for instance, it would seem that the separate anterior and posterior apertures, lying on either side of the articular surface for the quadrate, in the Dinornithidæ, have here become confluent, and now form one large aperture dividing the squamosal and otic articular surfaces for the quadrate far from one another. In the Sphenisci, by reason of the great depth of the temporal fossa lying immediately above, the greater part of this recess has become suppressed, only the lower end now remaining. In the Pygopodes the relatively greater depth of the temporal fossa, coupled with a general and marked tendency for the suppression of pneumatic tissue throughout the skeleton, have combined to obliterate the superior tympanic recess altogether.

[1] "Zur Morphologie des Vogelskelets." Nouveaux Mém. de la Soc. Imp. des Naturalistes, 1899.

The Squamosal Prominence.—In the more primitive forms, such as *Serpentarius*, *Polyboroides*, and *Pernis*, the squamosal prominence is very feebly developed. As usual, its inferior surface affords a glenoid cavity for the articulation of the squamosal head of the quadrate. Mesiad of this glenoid cavity is the aperture of the superior tympanic recess. The zygomatic process is very small; in *Serpentarius* it is wanting.

The squamosal prominence is seen at its best in the Falconidæ (including *Polyborus*), where it projects conspicuously from the skull-wall. The zygomatic process is excessively developed in *Polyborus*, where it hangs downwards, eaves-fashion, over the quadrate. In addition to this, is a second and equally large process depending from the antero-lateral angle of the lateral occipital wing, at its junction with the zygomatic process.

The postero-inferior angle of the squamosal, in *Polyboroides* and in the Falcons, develops a large, downwardly directed and pointed spike – the *processus articularis squamosi*. Between this and the zygomatic process just described, the squamosal head of the quadrate is tightly grasped. In *Serpentarius*, the Eagles, *Pernis*, *Pandion*, *Buteo*, *Circus*, *Gypaetos*, and many of the true Vultures, for instance, this articular process is but feebly developed. In Cathartæ it is wanting.

The *temporal fossæ* are for the most part but shallow, linguiform depressions in the parietal region of the skull, and which never extend backwards to meet the mid-dorsal line. In *Serpentarius* they are exceedingly shallow and scarcely rise above the level of the base of the postorbital process. They are best developed in the Falcons and *Polyborus*, where they extend inward to within a a short distance of the cerebellar prominence.

The *trigeminal* foramen is completely isolated, lying far removed from the mouth of the superior tympanic recess, and considerably in front of a line drawn transversely through the skull across the squamosal head of the quadrate.

The *orbits* are large. In *Serpentarius* they are protected from above by wide overhanging ledges formed by the frontal bones, behind, and by large, horizontal, backwardly-directed, flattened plates developed by the lachrymal, in front. These, one on either side, fit closely to the frontal. In the higher Accipitres the width of the interorbital region of the frontals is much less, the free edge forming a deep hollow. In this case the horizontal process of the lachrymal is left as an isolated spur projecting on either side of the roof of the skull and overhanging the orbits. In the majority of such cases, the length of the spur is increased by the addition of a separate scale-shaped ossicle—the superciliary ossicle. This is attached to the lachrymal by connective tissue. In the Falcons and Vultures it fuses with the lachrymal. In the Cathartæ the supra-orbital limb of the lachrymal is suppressed, the lachrymal itself fusing completely with the frontal.

The *orbito-sphenoid* is completely ossified in all the Falconiformes.

The *interorbital septum* is pierced only in the lower members of the various groups of Falconiformes. For instance, in *Serpentarius* and *Cathartes*, in *Pandion* and *Pernis*, *Polyborides*, *Gypohierax*, and the lower Vultures and Eagles.

The Ethmoidal Region.—The *mesethmoid*, as in Neognathæ generally, is, as it were, obliquely truncated at its anterior end, so that its free edge slopes upwards and forwards. This is due probably to the shortening of the parasphenoidal rostrum. This shortening process is very conspicuous in the Accipitres. It rarely, if ever, extends forwards beyond the level of the lachrymals in any Neognathæ. In the Palæognathæ this rostrum extends forwards for a considerable distance in front of a line drawn transversely through the skull across the lachrymals. The mesethmoid extends backwards, as in all other birds, to fuse with the orbital plate of the frontal, and the orbito- and presphenoid, and the parasphenoidal rostrum below; thus forming the interorbital septum referred to above. From the neighbourhood of its truncated anterior border springs, on either side, a more or less extensive wing-like process—the *prefrontal* or *antorbital* plate.

The *prefrontal* is somewhat feebly developed in *Serpentarius*, *Polyboroides*, and *Pernis*, for instance. In Cathartæ and in the Falcons it is much larger; in the latter it extends outwards to afford a more or less extensive lateral support for the lachrymal. In the former, the lachrymal and prefrontal relations become still more intimate, since they fuse one with another.

The *preorbital region* of the mesethmoid expands dorsad into a broad horizontal plate underlying the anterior ends of the frontals, the nasals and the nasal processes of the premaxillary. In the Vultures, Eagles, and Cathartæ markedly, and in the majority of the Accipitres to a less extent, the free edges of the horizontal aliethmoidal plate turn downwards and inwards, and finally backwards, to join the prefrontal; thus forming an ossified olfactory chamber. This is most perfectly developed in the Cathartæ, where the chamber is of very considerable extent, recalling that of the Tubinares. In *Serpentarius*, the Falconidæ, and Buteonidæ, this ossified olfactory chamber is extremely reduced. In the two latter forms perhaps the great development of the prefrontal may be regarded as filling the place of the ossifications of the horizontal plate.

The olfactory nerve, in leaving the skull, generally travels along a groove in the dorsal border of that portion of the mesethmoid which forms the interorbital septum; sometimes this groove is covered in by the ossification of connective tissue, *e. g.* Cathartæ.

I would revert once again to the comparison between the olfactory chamber of Cathartæ and that of the Tubinares. In the former the free edge of the horizontal aliethmoidal plate turns downwards on either side mesiad of the lachrymal, so as to leave a considerable space between itself and the lachrymal, to form the Harderian fossa. Furthermore, it would seem that the

aliethmoidal extensions of this plate extend backwards so as to form a complete olfactory chamber leading backwards directly, tunnel-wise, into the brain-cavity, through the apertures for the olfactory nerve.

In the Tubinares we have a very similar olfactory chamber, but of far greater size. This is due to the fact that the prefrontal, which is enormous, arises so far back that the interorbital septum is reduced to a small ring of bone surrounding the interorbital fenestra. Furthermore, the backward position of the prefrontal has involved it in the formation of the lower lateral segment of the aperture for the olfactory nerve, which may also be legitimately described as enormous. The upper lateral segment of this circular aperture is formed by the downturned edge of the horizontal aliethmoidal plate. Normally, in Neognathæ, the olfactory nerve leaves by a small foramen pierced through the free edge of the orbital plate of the frontal and the perpendicular plate of the mesethmoid, runs in a groove along the dorsal border of the plate, and thence gains the olfactory chamber. In the instance we have just examined, the olfactory aperture opens *directly* into the chamber.

It is possible that the conditions which obtain in the Tubinares may represent a primitive stage, the olfactory chamber having been pushed forwards by the great development of the orbits, demanded by the increasing size of the eye. In *Apteryx*, where the eyes are very small, the olfactory cavity is in close juxtaposition with the brain-case. The fact that the chamber is of still greater relative size, and very complicated internally, only indicates a further specialization of the primitive condition. In the Palæognathæ we may trace several stages in the forward shifting of the olfactory chamber correlated with increased size of the eyes and orbits; as a study of the skulls of *Dinornis*, *Struthio*, *Dromæus*, *Rhea*, and *Tinamus* will show.

The development of the olfactory cavity is a point which will evidently repay further investigation.

The nasal septum is divided by a considerable gap, or cleft, from the mesethmoid. This cleft, the cranio-facial fissure, is widest ventrally; the mesethmoid and nasal septum being in contact immediately below the nasal processes of the premaxilla. In the Cathartæ alone among the Falconiformes, the external nares are pervious, only the proximal portion of the nasal septum being present. This, in *Pseudogryphus californianus*, extends forwards for a short distance to encroach upon the external narial aperture, and is pierced by a round fenestra. This posterior portion of the nasal septum, in Cathartæ, expands to form a broad base which, extending outwards on either side, joins the widely separated maxillo-palatine processes, and so converts a schizo- into an indirectly desmognathous palate. In many of the true Vultures, e. g. *Gyps*, by the ossification of the alinasal ectoethmoidal wall, the nostril, in the dried skull, is of the same shape as in life. The olfactory region of the nasal labyrinth, in *Gyps*, is provided

with an ossification of the basis of the *choncha media* which projects into the cavity from the outer wall. In the true Falcons the ossification of the aliethmoid causes the anterior nares to be round in form as in life, in *Polyboroides* crescentic. In both, the aperture displays within its mouth a small median bony papilla--the papilla of the *conchæ vestibulum* of Suschkin, the alinasal turbinal of W. K. Parker. The details of the structure of the cartilaginous nasal labyrinth and its ossifications have been exhaustively worked out and beautifully illustrated by Dr. Suschkin in his masterly monograph on the skull of *Tinnunculus*.

The Cranial Cavity.- The *metencephalic fossa* of the Falconiformes is more basin-shaped in the smaller than in the larger forms. Moreover, in these smaller forms the anterior region of the fossa is tilted upwards and backwards so as to form an acute angle with the long axis of the skull. The *trigeminal foramen*, in *Falco* for instance, is sharply cut off from the mesencephalic fossa by an overhanging ledge of bone. The orbito nasal foramen also lies immediately under this ledge. In the Vultures, the upper ledge of bone overshadowing these apertures is less extensive, so that they come to lie partly in the floor of the mesencephalic fossa. The apertures of the vagus and internal auditory meatus do not offer any very important points of difference for comment.

The *cerebellar fossa* is sharply defined and variable in relative proportions, being, for instance, larger in *Falco* than in *Vultur* or *Circus*. The *floccular fossa* is, in *Falco*, cordiform, and apparently rather shallower than in other forms.

The *mesencephalic fossa* is very sharply defined. It is banded above by a broad overhanging ledge formed by the tentorial ridge. The distinctness of its inferior border is blurred, in *Vultur*, by the apertures of the trigeminal and orbito-nasal nerves, which lie in the floor of the fossa. In *Falco* these are shut off from this fossa by a bony shelf, and open inward into the dorso-lateral border of the metencephalic fossa.

The *pituitary fossa* is deep and tubular, and passes almost vertically downwards. The hinder boundary of this fossa, the *dorsum sellæ*, forms a narrow ridge passing forwards and upwards to terminate above the oculo-motor foramen. The anterior border of the fossa is bounded by the transverse pre-pituitary ridge, which passes forwards into a narrow, sometimes triangular, optic platform, on either side of which lie the optic foramina. The optic platform is continued upwards, forwards, and backwards into the *pre-optic ridge* which may be traced, in *Circus* for instance, on either side into the tentorial ridge. In the majority of other forms, probably, it disappears before reaching this, e. g. *Vultur*, *Falco*.

The *oculo-motor* lies immediately caudad and ventrad of the optic foramen. It is continued backwards in a rather wide groove into the dorsum sellæ. Below and anterior to this foramen is the aperture for the internal ophthalmic artery--when this is separate. It opens into the pituitary fossa some distance from the

aperture for the internal carotid. The pathetic lies dorsad of the oculo-motor foramen, and may be continued backwards and downwards by a groove terminating above the orbito-nasal foramen.

The *cerebral fossæ* do not lie altogether in front of, but rather exhibit a tendency to overlap the cerebellar fossæ. The lateral extension of the cerebral fossæ is very marked. The fossæ are conspicuously depressed dorso-ventrally. This is most noticeably so in *Falco*: the distance between the point where the right and left tentorial ridges converge to join the median bony falx and the prominent triangular bony boss which bounds the mesencephalic fossa posteriorly being considerably less than in *Vultur*.

The *olfactory fossæ* are represented by a small median pit leading forwards into two narrow apertures for the optic nerves.

The Premaxilla.

The *premaxilla*, in all the Falconiformes, is more or less distinctly hooked at the tip. In length and stoutness it varies.

In the Falcons and *Polyborus* it is short and wide and much hooked. The tomium, in Falcons, is notched, or rather is provided with a distinct "tooth." The palatal surface in both Falcons and *Polyborus* is extensive and marked by a well-defined median ridge, passing backwards in the maxillo palatine processes. This ridge is faintly represented in *Serpentarius*.

In many Vultures, the palatal surface of the premaxilla is more or less deeply hollowed (Plate XXXI. fig. 5); the excavation being most noticeable in the larger forms. In others, where the breadth is slender, the palatal surface is but slight, passing rapidly backwards into a groove filled by the ventral border of the nasal septum.

In the majority of the Falconiformes, the palatal surface of the premaxilla resembles that of the smaller Vultures—is slight, bifurcate, and filled by the ventral surface of the nasal septum.

The Cathartæ differ markedly from all the other Falconiformes in the form of the palatal surface of the premaxilla. In these last the body of the premaxilla is very highly pneumatic, a section thereof revealing a mass of cancellated tissue between two dense plates of bone. This increase of pneumatic tissue brings the palatal surface down close, or very near to, the level of the tomium. In the Cathartæ this pneumatic tissue is almost wanting, so that the palatal surface comes to form a vaulted chamber. The resemblance in the structure of the premaxilla to the Tubinares is very striking.

The fusion of the nasal processes of the premaxilla with one another and with the nasals is very complete in all the Falconiformes.

In *Microhierax* the beak articulates with the skull by means of a fronto-nasal hinge as in Parrots and some other birds.

In the Cathartæ the fused lachrymal and frontal combine to

form, with the nasal bones, a more or less perfect fronto-nasal hinge, see also p. 291. There is no transverse hinge as in *Microhierax* or in Parrots.

The Maxillo-Jugal Arch.

The maxilla is indistinguishably fused with the premaxilla. The maxillo-palatine processes have slowly increased in size so as to convert what was originally a schizognathous into a desmognathous palate. Many intermediate stages in the course of this transformation have been preserved and will be discussed forthwith.

In the study of the transition of the palate from the schizognathous to the desmognathous type, we will commence with *Elanus*: this form being regarded by Dr. Suschkin as exhibiting more primitive characters than any other Accipitrine bird.

In *Elanus* then (Pl. XXXI. fig. 2) the maxillo-palatine processes turn inwards in the form of a pair of small, very pneumatic, hamulate processes. Although they hem-in the vomer on either side, they do not extend so far inwards as to touch it. Distad of the vomer they are hidden by the palatines, and thus leave a large median palatal vacuity exposing the nasal septum above and lying in the middle line. The maxillo-palatine processes themselves are pierced, laterad of the palatines, and between these and the tomium, by a large foramen. The palate, however, of *Elanus* is not, I think, to be regarded as primitive, but specialized (see p. 313). *Circaëtus* (Pl. XXXI. fig. 4) is also schizognathous, and probably represents the intermediate type of palate which has given rise, by specialization, in one direction to the palate such as is found in *Elanus* and the Cathartæ, and in the other to such as obtains in the Vultures and Falconidæ.

In *Aquila* (e. g. *A. chrysaetos*, *A. audax*), *Spilornis*, and *Thrasaëtus harpyia* we find the maxillo-palatines greatly increased in size antero posteriorly, and extending inwards mesiad of the palatines: so much so as to almost completely fill up the space between them. The nasal septum is now visible only through a narrow palatine clink. This increase in bulk has now caused the maxillo-palatines so nearly to approach one another, that they almost, if not quite, touch. But they are yet distinct, and the palate must accordingly be regarded as schizognathous.

In *Serpentarius* they touch throughout the greater part of their length, concealing the nasal septum (Pl. XXXI. fig. 7).

Indirect desmognathism, brought about by the downward extension of the nasal septum, obtains in the majority of Accipitres, and can best be studied in such forms as *Elanoides*, *Pandion*, Vultures. In *Gypaëtus* and *Neophron*, for example, the maxillo-palatines do not meet in the middle line, and but for the nasal septum would be bounded anteriorly by a large palatal vacuity as in *Cathartes*.

Direct desmognathism is perhaps only found in Falconidæ.

In all the desmognathous palates the maxillo-palatine processes remain free posteriorly.

In the Cathartæ we have a palate of quite peculiar type (Pl. XXXI. fig. 1). The maxillo-palatines, as in *Elanus*, are relatively small. But whilst, in *Elanus*, it will be remembered, they were of a spongy texture, in Cathartæ they are represented by a shell-like lamina with its concavity downwards. The external lateral border of this lamina is anchylosed with the nasal. The antrum is represented by a small cavity at the extreme anterior extremity of the plate. These shell-like laminæ fail to meet in the middle line; nevertheless the palate must be regarded as of the indirect desmognathous type on account of the fact that the nasal septum expands ventrally into a horizontal plate, fusing on either side with a pair of strap-shaped laminæ arising from the inner dorsal border of the maxillo-palatine processes (=the anterior septo-maxillary spur, *Parker*). Distad of the maxillo-palatines and nasal septum is a large anterior palatal vacuity roofed only by the nasal processes of the premaxilla. This region of the jaw recalls that of the Tubinares. But the palate of the Tubinares differs in the absence of an ossified nasal septum and the great size of the vomer.

The jugal is wanting from the quadrato-jugal arch in the Falcons. It is certainly present in *Accipiter*, and perhaps in other Accipitres.

In some examples of *Hierofalco* the quadrato-jugal bar is connected with the maxilla by a distinct joint. The maxilla contributes towards this articulation a backwardly directed, columnar bony process, which immediately overhangs the extreme posterior angle of the tomium. Seen from below, the articulation is transverse in form. From above, it is concealed by a spike of bone from the quadrato-jugal, which projects forwards into the mouth of the antrum. The sporadic formation of a joint in this position seems to me a point of some considerable interest.

The Vomer, Palatine, and Pterygoid.

The *vomer* in the Accipitres is never a very large bone. It is blade-shaped when completely developed, and sometimes is slightly bifurcated at its extreme posterior end—seen from the ventral surface. Its base is received between the anterior borders of the dorsal laminæ of the posterior expanded end of the palatine: sometimes fusing therewith, e. g. *Serpentarius*. In the Falcons the vomer terminates in a bilobate expansion which rests upon the fused maxillo-palatine processes, between their free posterior projections. In *Polyborus* and *Milvago* this expansion is barely perceptible. In *Milvus* (e. g. *M. ater*), *Haliastur*, *Pernis*, and *Buteo* (e. g. *B. jakal*) the vomer is long and slender, and anchyloses with the maxillo-palatines. In *Aquilinæ* the vomer extends far forwards between the maxillo-palatines, but remains perfectly distinct therefrom.

In the Vultures the vomer appears to be wanting, save in *Gypaetus*, where it is large. In *Neophron* and *Gypohierax* vestiges remain, and it may be that these traces are lost in maceration in other skeletons. In the remaining Accipitres it is either vestigial or wanting.

The *palatine* perhaps more nearly resembles that of *Cariama* than any other. It extends forwards as far as or slightly beyond the level of the external narial apertures, running beneath the maxillo-palatine process. It increases gradually in width from before backwards, reaching its maximum expansion at a point immediately below the prefrontals. From this point backwards it comes into relation with the parasphenoidal rostrum; the palatine of the right and left sides combining to form a narrow, very shallow trench, gliding up and down the rostrum with the movements of the facial apparatus. That portion which is connected with the rostrum is somewhat scroll-like in form, the free anterior edge of the scroll passing downwards and forwards into the mesial border of that portion of the palatine which is continued forwards to terminate below the maxillo-palatines as a rod- or rather strap-shaped blade. Seen from below, it would seem as if the scroll-shaped region of the expanded palatine plate were caused by a grooving out of substance of the palatine itself, causing a deep median trough, bounded on either side by a sharply-defined ridge representing the mesial border of the palatine, e. g. *Elanus* and *Serpentarius*. In other Accipitres, in varying degrees, this ridge projects downwards and forms a more or less conspicuous keel. This keel is especially strongly marked in the Falconidæ.

The *pterygoid* in the lower forms, e. g. *Serpentarius*, *Cathartes*, bears an articular surface for the basipterygoid process. In the Accipitres it forms either a cylindrical or twisted rod-shaped bone. The adult palato-pterygoid articulation is of the typical Neognathine type in all but *Pandion*. In *Pandion* the anterior end of the pterygoid is Y-shaped, the external fork of the Y articulating with the external postero-lateral angle of the palatine. This is, so far as I am aware, a quite unique feature; but nevertheless a quite secondary character, and in no way comparable to the forked pterygoid of *Apteryx*.

The maxillo-jugal bar in the Cathartæ furnishes some interesting matter for study, in certain peculiar features connected with its anterior end. These features may be traced through a series of stages gradually increasing in complexity, and associated with a gradually developing fronto-nasal hinge.

In *Cathartes* (*C. aura*) this bar, when it reaches the middle of the lachrymo-nasal fossa, splits into a long inferior dorso-ventrally depressed lamella and a superior shorter rod-shaped portion, which extends forwards to within a short distance of the maxillary process of the premaxilla. [In one skull (1186 *b*) in the Museum Collection, on the left side, the terminal portion of this maxillary process, it should be mentioned, is segmented off to form a very small separate triangular ossicle.]

In *Catharistes* the fission of the bar takes place much further forward than in *Cathartes*, and the short superior segment is abruptly truncated and roughly articulates with the aforesaid maxillary process of the premaxilla.

In *Gypagus* this inferior limb remains much as in *Cathartes* and *Catharistes*, but the superior limb now forms a shorter but laterally compressed lamina with a hollow anterior border fitting into the rounded posterior border of the maxillary process of the premaxilla.

In *Pseudogryphus* and *Sarcorhamphus* the short, laterally compressed upper limb now forms a spatulate process, working in opposition to a shallow depression in the maxillary process of the premaxilla.

The gradual development of these peculiar articulations seems to have gone hand in hand with the development of a nasal hinge, formed by a deep notch hollowed out of the anterior border of the lachrymal, for the reception of a "tooth-shaped" process borne by the outer border of the nasal. This forms the hinge; the necessary movement of the beak upon the skull is afforded by the elasticity of the nasal and premaxillary processes lying mediad of the right and left notches. This hinge is most perfect in *Gypagus*, *Pseudogryphus*, and *Sarcorhamphus*. In *Catharistes* the lachrymal is only barely perceptibly notched. A further study into the origin of structures like the present would prove profitable. Are they to be ascribed to kinetogenesis?

The composition of the quadrato-jugal bar, as revealed by an immature skull of *Cathartes*, is interesting, and chiefly on account of the large share which is borne by the maxilla. This, together with the jugal, extends backwards as a long slender bar to within a short distance of the quadrate articulation. The jugal terminates anteriorly to meet, and sometimes articulate with, the maxillary process of the premaxilla, and apparently in *Pseudogryphus* and *Sarcorhamphus*, for instance, becomes much broadened to make the articulation the more complete. The quadrato-jugal appears to terminate at about the middle of the inner aspect of the bar. A slightly older skull of *Serpentarius*, but still showing traces of sutures, agrees very closely with what has just been described in *Cathartes*. The great backward extension of the maxilla appears to be a Neognathine character.

The Mandible.

The mandible of the Accipitres is truncated posteriorly, and has a very long internal angular process. It very closely resembles that of the Bubonine section of the Striges, so much so as to require very careful discrimination. In comparing mandibles of these two groups, it will be found that among the Accipitres the two rami form a less open angle one with another, and the ventral aspect of the internal angular process is not marked by a median ridge. The lateral vacuity in the mandible

of the Accipitres is wanting save in the Falconidæ, wherein it is conspicuous. It differs, however, from that of the Striges (1) in that the coronoid extends forwards along its whole length, and (2) in that there is a small foramen lying immediately behind and above the vacuity for the passage of the mandibular branch of the trigeminal. Furthermore, the external lateral border of the articulare develops a strong upward and backwardly directed hook-like process forming a deep notch between itself and the extreme postero-lateral angle of the jaw.

In the Striges, the Bubonidæ have the coronoid terminating in a spike-like fashion near the middle of the lateral mandibular vacuity. In the Strigidæ the vacuity is much smaller; and the coronoid terminates in front of it, in a truncated and spatulate process. The V-shaped angle of the jaw is similar to that of the Accipitres; but the internal angular process is relatively more feeble, and the inferior border of the jaw is sinuous, whilst in the Accipitres it is nearly straight.

The Hyoid.

The basihyal is partly ossified; short ceratohyals are also represented. The basibranchial has a diamond-shaped body continued backwards into a long style, representing the 2nd basibranchial (urohyal). The ceratobranchials are long. The epibranchials are more than half as long as the ceratobranchials.

iii. The Vertebral Column.

All the presynsacral vertebræ are heterocœlous. In all, save the Falconidæ and Polyboridæ, the thoracic vertebræ are free. In the two families just mentioned all the thoracic vertebræ are ankylosed save the penultimate, which is free. *Herpetotheres* is the only exception to this rule, having all the thoracics free.

The cervical vertebræ are relatively thick and short, and have in the larger forms a somewhat swollen and massive appearance. The ankylosed cervical ribs, which are present in all but the atlas and axis, never extend backwards as far as the end of the centrum. The anterior lateral border of each is produced upwards into a flattened plate, forming the outer wall of the vertebrarterial canal. This pleurapophysial lamella is short antero-posteriorly, its posterior border never extending as far backwards as the middle of the centrum. The dorsal border of this lamella never unites with the centrum to enclose a fenestra opening immediately behind the posterior zygapophyses, as in *Cariama* for instance. Neural spines take the form of low median tubercles: in the smaller forms these are but feebly developed. In the 2nd to 4th vertebræ the neural spines are moderately long and columnar, especially in the Falcons; the posterior angles of the 2nd and 3rd turn upwards into blunt tubercular hyperapophyses. In *Pandion* the neural spines are obsolete, but the

hyperapophyses are particularly well developed. The 2nd to 4th vertebræ bear hypapophyses: beyond these they are replaced by catapophyses, which near the cervico-thoracic vertebra again give place to hypapophyses. These catapophyses never coalesce to form a carotid canal. In many of the larger Accipitres the cervical vertebræ from say the 5th to the 8th have the neural plate deeply excised posteriorly, so that the postzygapophyses appear, each as an articular facet at the extremity of a long beam. The ventral surface of the centrum is either flattened or slightly grooved.

There is a very close similarity between the cervical vertebræ of the Accipitres and the Striges: so close is this resemblance that the one is hardly distinguishable from the other. The chief differences appear to be in the fact that the cervical ribs of the Striges are relatively slightly longer and the catapophyses somewhat more sharply defined. The pleurosteal lamella is also somewhat more band-like and sharply defined. The hyperapophyses of the axis are abruptly truncated in the Owl, tubercular in the Accipitres. For the rest, the differences are not greater than those which normally obtain between species or genera, at most.

The cervici-thoracic vertebræ may be two or three in number.

The thoracic vertebræ, as already remarked, are free save in the Falconidæ and Polyboridæ. When free, they may be distinguished from those of the Strigidæ in that the neural spines are relatively lower, wider antero-posteriorly, and not markedly inclined forward. Hypapophyses in the Strigidæ do not extend beyond the second vertebra: in the Accipitres with free vertebræ to the third. In the Strigidæ there may be a large pneumatic aperture between the articular surfaces for the capitulum and tuberculum, and a second caudad of this. As in the Accipitres so in the Striges, each transverse process sends forward and backward a long slender spike from its extreme lateral border; each spike overlaps similar spikes from the vertebra next in front and behind it. The neural spines may also send backwards from the upper border a pair of short spike-like processes, to embrace the neural spine immediately behind it.

In *Serpentarius* the thoracic vertebræ, from the 2nd to the 5th, are pierced by a large pneumatic foramen, opening at the base of the neural spine immediately behind the anterior zygapophysis. This leads into an extensive chamber, excavated out of the vertebral tissue and extending down to the spinal cord, being separated therefrom only by a thin plate of bone. Other pneumatic apertures pierce the lateral walls of the neural tube, and the centrum below this.

In the majority of the Accipitres, the pneumatic apertures of the thoracic vertebræ are restricted to a single opening at the base, and caudad of the transverse process and immediately in front of the base of the postzygapophysis.

In the Cathartæ the apertures are three in number, and lie on

either side of, rather than between, the capitular and tubercular glenoid surfaces.

In the Falconidæ, excepting only *Herpetotheres*, and in Polyboridæ, as already remarked, the thoracic vertebræ 1–4 are ankylosed into a single mass. But this mass also includes the last cervico-thoracic vertebra, so that the whole is made up of five vertebræ. The penultimate thoracic vertebra is free, the ultimate is fused with the synsacrum; so that this free vertebra serves as a hinge in the middle of the back. In some examples of *Polyborus* the antepenultimate vertebra may show traces of its former existence. Such specimens are probably not quite adult.

It is probable that the last two cervico-thoracic vertebræ have not long been transferred to the cervical series, for the dorsal segment of the ribs belonging thereto has as yet undergone no shortening. Those of that vertebra which has ankylosed with the thoracic still retain their uncinates.

In the Falconidæ and Polyboridæ only one, and in other Accipitres two thoracic vertebræ appear to enter into the synsacrum.

The *synsacrum* includes from 12 to 14 vertebræ. In *Serpentarius* it is composed as follows:—2 thoracic, 4 lumbar or crurosacral, 2 lumbo-sacral or ischiadic, 2 sacral, and 4 caudal vertebræ.

The anterior renal fossa (fossa ischiadica) in *Serpentarius* is very lofty and narrow; when seen from the ventral aspect, recalling that of *Cariama*. The posterior renal fossa is long and narrow. This last fossa is bounded by a very broad *planum anale*, and this appears to be peculiar to *Serpentarius*, amongst the Falconiformes.

In the Accipitres, the form and size of these fossæ vary much, as is indicated by the following illustrations. It is impossible, however, to do more than indicate the general nature of the form of these fossæ, for they vary in details in almost every species. The anterior renal fossa forms a narrow and lofty chamber, longer than the posterior fossa, in *Busarellus*, *Circaëtus*, *Haliaëtus*, *Haliastur*, *Lophaëtus*, *Gypohierax*, and *Antenor*. It is narrow, lofty, and shorter than the posterior fossa in *Parabuteo*, *Aquila*, and *Spizaëtus*. It is wide, lofty, and longer than the posterior fossa in *Falco*, *Chimachima*; wider, lofty, and shorter in *Elanoides* and *Polyborus*. In *Pandion* both these fossæ are exceptionally large, and of the type seen in *Elanoides*. In *Spizaëtus* the *posterior renal* fossa has reached the minimum limit of reduction, including but a single caudal vertebra.

It will thus be seen that the form of these fossæ is of little or no value for taxonomic purposes other than the identification of species. The lofty and narrow type appears to belong to the more specialized, the wide and shallow to the more primitive members of the respective groups to which they belong.

In *Pandion*, there are three and sometimes four lumbar or cruro-sacral vertebræ, and these are more sharply defined than in the other Accipitres. The lumbar possess well-developed dorso-lateral processes. The sacrals are, in the skeleton, indistinguish-

able from the postsacral (caudal) vertebræ by reason of the long slender ventro-lateral processes of these last, which in no respect differ in appearance from the sacral ribs. Thus the posterior renal fossa (*fossa pudendalis*), which is large, is cut up into a number of separate compartments.

There is a certain resemblance between the synsacra of *Pandion* and *Cathartes*. But the two may readily be distinguished. In *Pandion* the lateral iliac fossa (*fossa lumbaris*) is peculiar on account of the great size of the ventri-lateral processes, the outer ends of which are fused one to another to form a bony bar, upon which the preacetabular ilium rests. The dorsi-lateral processes forming the roof of the anterior and posterior renal fossæ give rise to a large, flat, imperforate plate with convex free borders, showing a distinct suture-line betwixt them and the postacetabular ilia. The intervertebral foramina are almost completely obliterated.

In *Cathartes* the ventri lateral processes of the lateral iliac fossa are less conspicuously developed. The roof of the anterior and posterior renal fossæ is perforated by large intervertebral foramina; and the lateral edges of the plate forming the roof of this fossa is deeply hollowed both before and behind the sacral vertebræ. There are 6 to 8 postsynsacral vertebræ (free caudals) including the pygostyle. The anterior of these vertebræ bear vestiges of the anterior zygapophyses, which gradually decrease in size from before backwards.

In *Serpentarius* the neural spines are swollen and bifid, the transverse processes are pierced at the base by comparatively large pneumatic apertures. The last 3 or 4 vertebræ bear bifid hypapophyses. The free caudals of *Gypaëtus* resemble those of *Serpentarius* but are non-pneumatic. In the larger Eagles the transverse processes are much expanded and very wide. The number of caudal vertebræ included in the synsacrum appears to vary between 1 (*Spizaëtus*) and 4 (*Serpentarius*). In the Falconidæ the pygostyle bears a pair of accessory plate-like vesicles, attached by their hinder border by ligament to its inferior angle, and projecting forwards as a horizontal plate. Intercentra occur.

iv. THE RIBS.

The cervical ribs extend from the third vertebra backwards, and are ankylosed with their respective vertebræ. They are relatively longest in *Serpentarius*. The free, so-called cervico-thoracic belong more correctly to the thoracic series.

The thoracic ribs range from 5 (*Pseudogyps*, *Polyboroides*) to 8 pairs. The 8th pair, however, is never complete: often, as in *Spizaëtus* for instance, only the sternal segment is present, fixed by membrane to the 7th pair of sternal ribs. Sometimes the thoracic and sternal segments are widely separated by loss of the intermediate ossified tissue, as in a case of *Aquila chrysaëtos*. Whilst in other cases the thoracic and sternal segments are

normally related, yet the latter fails to reach the sternum. In some cases the last pair of sternal ribs may be represented only by vestiges fused with the last fractional pair.

The uncinates vary considerably in their development. In the *Polyborinæ* and the Falcons the uncinates are long and slender; but in the remaining Accipitres the base of attachment to the rib has increased enormously, extending often nearly as far down as the articulation with the sternal segment. In the Cathartæ, and in some species of *Aquila*, the inferior angle of this base is produced into a short spine. Generally the uncinates do not extend backwards beyond the level of the rib next behind. This is exceeded in *Elanoides*, and in *Pandion* (in *P. carolinensis*) they extend each to the third rib. In *Serpentarius* the uncinates are very degenerate, losing themselves in the rib, forming thereon nothing but a broad irregular plate. The uncinate of the first thoracic rib, however, is less degenerate, projecting distinctly backwards.

The preacetabular ilium overlaps from two to three pairs of ribs.

v. The Sternum and Pectoral Girdle.

Perhaps the most striking features of the sternum of Falconiformes are the great size of the *corpus sterni* and the relatively slight development of the carina. Amongst the different members of the group, however, much variation occurs, in the relative proportions in the length and breadth of the sternal plate, the development of the keel, the position of the coracoid grooves and articular surfaces for the sternal ribs, and the development of notches or fenestræ on the metasternum.

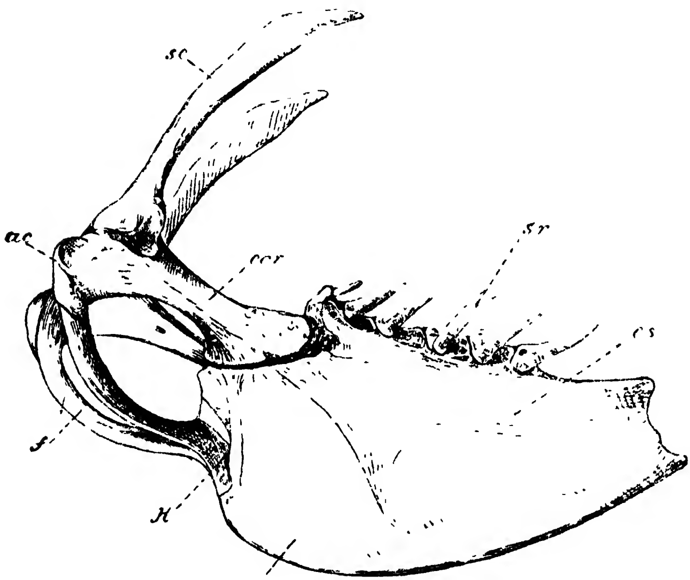
In *Serpentarius* (text-fig. 33, p. 297) the sternum is distinctly Ciconiine in character, not only on account of the great size and shape of the carina, but also in the fact that the latter affords a broad articular surface for the furcula. There is one peculiarity about the keel of *Serpentarius*, however, and this lies in the fact that the carina, swollen by pneumatic tissue, passes gradually into the corpus sterni. This last, it should be mentioned, is pointed posteriorly, instead of notched as in the Storks.

The sternum of the Cathartæ is peculiar in that the greatest curvature of the free margin of the carina is near its middle, and in that the keel extends backwards to the extreme posterior end of the sternal plate. The corpus sterni is notched posteriorly, and in *Cathartes* the posterior lateral processes are fenestrated. The coracoid grooves are shallow and broad, curving abruptly upwards and inwards to the middle line, not overlapping. The spina externa and interna are both wanting. The linea aspera for the origin of the subclavius extends backwards to within a short distance of the posterior end of the sternal plate: thus extending further back than in any other Falconiformes.

In the Falcons only is there a distinct *spina interna*; in *Herpetotheres* it is very broad and deeply hollowed; the *spina externa*

is present in all the Accipitres. In the Falcons only does the anterior angle of the carina project forwards as far as the level of the spina externa. Again, whilst in nearly all the other Accipitres the sternal ribs attach themselves along the whole outer border of the anterior lateral processes, in the Falcons the distal third is ribless. In the larger Falcons the sternal plate is fenestrated posteriorly, but in the small forms—*Melierax*, *Poliohierax*, *Microhierax*—it is notched. In Falcons, the coracoid

Text-fig. 33.



Left lateral aspect of the Sternum and Shoulder-girdle of *Serpentarius serpentarius*, showing the articulation of the furcula with the carina.

ac. = acrocoracoid.
cor. = coracoid.
cs. = corpus sterni.
H. = hypocleideum.
car. = carina.
f. = furcula.
sr = sternal rib.

grooves overlap one another, and the spina externa is relatively long and pointed. The articular surfaces for the sternal ribs extend backwards as far as the middle of the sternal plate.

The sternum of the *Polyborinæ* resembles that of the Falcons, but the *spina interna* is shelf-like instead of spiny, and the anterior border of the keel does not project so far forward.

In the Buteonidæ (Suschkin) the *spina interna* is not developed. The *spina externa* varies much in size. Generally, it may be described as a short stout tubercle; but in *Accipiter* it becomes a

long spine, as in *Falco*. The sternum varies much both in its relative length and the form of its posterior border. Thus, this last may be either notched or fenestrated, or both, or it may be entire. As these are points which may vary in members of the same genus, they are of comparative little value save as specific characters.

The sternum with the relatively largest carina of this group is that of *Pandion*. The *carina* generally has its anterior border sloped backwards, but in *Accipiter* this border turns forwards and upwards, thus greatly increasing the length of the keel. The carina varies much in its development, generally passing insensibly into a sternal plate before reaching its hinder border, but in *Accipiter* and *Pernis*, for instance, the carina is carried back almost to the extreme free border of the sternal plate.

The sternum of the Accipitres resembles that of the Striges. In many cases this resemblance is rather close. The following characters will be found useful in determining between sterna belonging to these two very different groups. The posterior border of the sternum in the Striges is never entire and never fenestrated, but always notched. With the exception of the sterna belonging to the Strigidæ, and the sternum of *Huhua orientalis* of the Bubonidæ, there are two pairs of notches. The single pair of notches of *H. orientalis* are of great size. They lie on either side of the metasternum, and extending forwards to beyond the level of the middle of the posterior lateral process, cause the sternum of this bird to closely resemble that of *Microhierax*. The great difference in size, however, renders any possibility of confusion on account of this resemblance impossible. The single pair of notches of the Strigidæ resemble those of some Accipitres, e. g. *Elanoides*, in that they are very shallow, so that the posterior lateral processes pass almost insensibly into the metasternum, being divided therefrom only by a sinuous line. But the processes are relatively much longer in the Strigidæ than in the Accipitres, and the sternum is narrower. Furthermore, the sternum of the Owls of this group may be distinguished by the fact that the spina externa is obsolete. The *anterior lateral processes* in all the Owls are small. The articular surfaces for the sternal ribs never extend beyond the middle of the sternal plate, rarely so far as this. There is no spina interna.

The *coracoid* presents two forms:—(1) That which obtains in the Falconidæ only, wherein there is a distinct hook-like procoracoid process curving downwards till it touches the furcula; and (2) that in which this process is wanting.

In the Falconidæ we can distinguish the coracoid of the Falcones from that of the Polybori; inasmuch as in the former there is no trace of the *foramen supracoracoideum* in the dried skeleton, this being bounded internally by membrane only. In the Polybori this foramen is present.

Whether the foramen in the coracoid of the remaining Accipitres is really the *foramen supracoracoideum*, or a foramen pierced

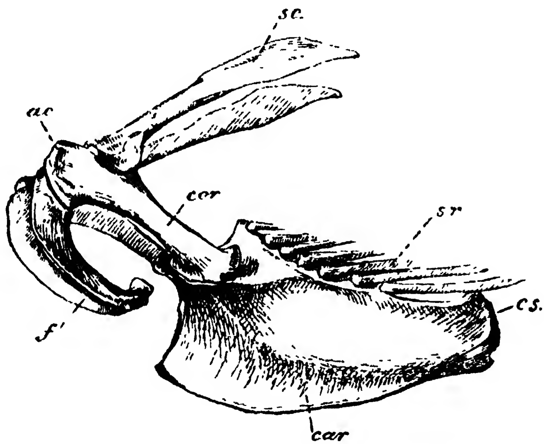
through the coracoid proper, for the passage of this nerve, is a point which can only be determined by an appeal to embryo and nestling specimens. Possibly it will be found that the foramen in the Polybori is also a coracoid foramen.

The coracoid is relatively of medium length in the Falconidæ, but proportionately longer in the little *Microhierax*.

In the Buteonidæ it is relatively short and stout, and very broad at the base, the distance across the latter region, at its widest part, being equal to the length of the shaft from the base to the articulation with the scapula.

In *Elanoides* the *processus lateralis basalis* is very conspicuous, more so than in any other member of the Order.

Text-fig. 34.



Left lateral aspect of the Sternum and Shoulder-girdle of *Aquila rapax*. The furcula does not articulate with the carina; and the latter terminates before reaching the end of the sternal plate.

Letters as in text-fig. 33.

The acrocoracoid process is large in both sections of the Order, and bears a facet for the articulation of the furcula--except only in *Serpentarius*, wherein this facet is wanting. The absence of a procoracoid process is sufficient to distinguish the coracoid of *Serpentarius* from that of the Storks.

The coracoid of the Cathartæ, like that of the Falcons, is relatively long.

The coracoid of the Accipitres closely resembles that of the Striges. In the latter group, however, the procoracoid process is always present; on this account, therefore, the coracoid of the Buteonine section of the Accipitres is always distinguishable. For the same reason—the lack of the procoracoid process—the coracoids of the Serpentarii and Cathartæ are also easily dis-

tinguishable. With the Falconidæ, however, the case is different; and it becomes a matter of nice discrimination to tell the coracoid of the Falcones, or Polybori, from that of one of the Striges. The Falcones may be distinguished by the absence of a supracoracoid foramen; but in the Polybori and Striges this foramen is present, and almost identical in size and position. The coracoid of the former can, indeed, scarcely be distinguished from that of the latter. In the Owls apparently the base of the coracoid is comparatively deeply grooved to fit the dorsal coracoid lip of the sternum; whilst in the Polybori, what corresponds to the dorsal lip of the groove in the Owls is represented only by a low and incomplete ridge; lastly, in the Owls the linea aspera for the coraco-brachialis posterior generally lies near the extreme lateral border of the coracoid shaft; in the Polybori it lies nearer the middle line.

The *scapula* does not afford much matter for comment of any systematic value. The acromial process in the Falconinæ is pneumatic and very broad, so much so as to project considerably into the *foramen triosseum*, thereby considerably diminishing its size. The acromion may be produced conspicuously forwards, and this is particularly well seen in *Neophron*, where it constitutes the greater part of the inner wall of the *foramen triosseum*.

The *furcula* in the Accipitres is remarkable for its great size and strength. It is U-shaped, with the limbs set wide apart, this latter feature being especially noticeable in the Buteonidæ.

In *Serpentarius* only does the furcula articulate with the *carina* (text-fig. 33, p. 297), as in the Storks. Furthermore, as we have already pointed out, *Serpentarius* agrees with the Storks in that the furcula does not develop a facet for articulation with the coracoid. It bears a hypocleideum of considerable size, directed downwards, and presenting a keel-like border for articulation with the carina.

In the Cathartæ only are the distal extremities pierced by a pneumatic foramen. This is very large and opens in the outer aspect of each limb, immediately behind the acrocoracoid.

In the Falconidæ the hypocleideum is vestigial or wanting. In *Microhierax* the furcula is not perceptibly bent upon itself, as in the larger members, nor are the limbs so wide apart. The length of the limbs of the furcula in *Microhierax* is relatively greater than in any other members of the order, since they equal the length of the *carina sterni*.

In the Buteonidæ the limbs of the furcula, as we have already remarked, are set widely apart, and are of great breadth at their distal ends; especially is this the case in such forms as *Gypaëtus*, *Haliaëtus*, and *Aquila*. The hypocleideum is vestigial or wanting. It appears to be largest in *Aquila* and *Pandion*. In some cases, *Elanus* for example, the proximal ends of the furcula are very slender, and in this particular the furcula resembles that of the Striges. The furcula of the Accipitres is more unlike that of the Striges than is the case with the sternum or coracoid, as

we have already shown. With the exception of *Serpentarius*, the furcula never articulates with the carina in Falconiformes. In the Striges, on the contrary, the furcula is always attached to the carina. Furthermore it is a much more slender bone than in the Falconiformes, and not bent upon itself.

vi. The Pelvic Girdle.

The pelvic girdle of the Falconiformes, through the more aberrant members of the group, bears resemblances on the one hand to that of the Gruidæ, and on the other to that of the Ciconiidæ; and, through the more specialized forms, to the Striges. The innominates are never free.

Serpentarius presents several Gruine characters, the most noticeable of which are the pocket-like cavities (iliac recesses) of the postacetabular ilium, and the general contour of the dorsal aspect of the pelvis as a whole.

The pelvis of *Serpentarius* is, however, distinguishable from the similar Gruine and Ciconiine pelves by the great height of the supra trochanteric process, and the enormous size of the ilio-ischiadic foramen. Furthermore, the ischium terminates posteriorly in a rounded or rather conical border projecting beyond the postacetabular ilium; whilst the pubis, which is long and slender, sends up a conical process immediately below the projecting extremity of the ischium, which serves more or less effectually to close the obturator fissure posteriorly.

The preacetabular ilia meet one another in the mid-dorsal line, and there is no trace of the suture between the postacetabular ilium and the transverse processes of the synsacrum. The synsacral fossæ lying between the neural spines and the postacetabular ilium are roofed over by a thin plate of bone. The obturator fissure is not separated from the foramen.

The pectineal process is wanting, not only in *Serpentarius* but in all the pelves herein described.

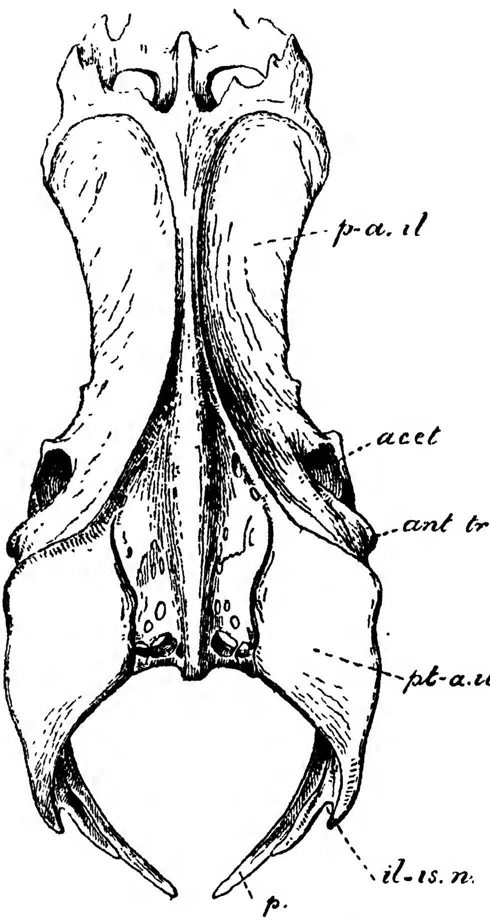
In the Cathartæ the pelvic girdle is, externally, distinctly Ciconiine in character. The resemblances are especially noticeable in the pelves of *Pseudogryphus* (text-fig. 35, p. 302), *Cathartistes* (text-fig. 36, p. 303), and *Gypagus*.

The presence of iliac pockets, however, at once distinguishes these pelves from those of the Ciconiæ. Another Stork-like feature is the deep notch in the hinder border of the innominate, marking the division between the now fused ilium and ischium. In *Sarcorhamphus*, *Pseudogryphus* (text-fig. 35, p. 302), and *Gypagus* the inferior limb of this notch is produced backwards for a very considerable distance beyond the postacetabular ilium to form a long spine. In the degree of development, and in the position of the supra-trochanteric process, the innominate of the Cathartæ is Gruine.

The pelvis of *Cathartes* differs markedly from that of the other genera in this: That whilst in the genera just discussed the

preacetabular ilia rise above the synsacrum to meet one another in the middle line; in *Cathartes* they are widely separated one

Text-fig. 35.



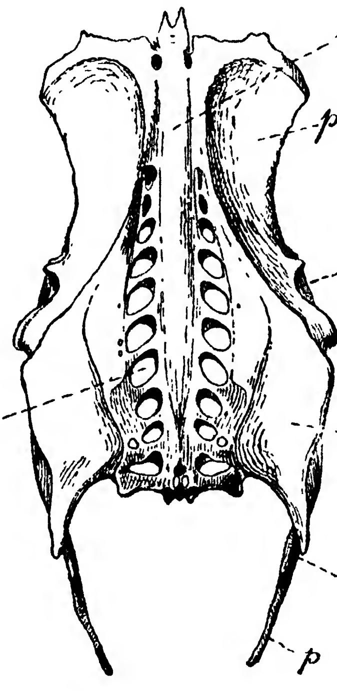
Dorsal aspect of the Pelvis of *Pseudogryphus californianus*, showing the Ciconiine character of the pelvic girdle. The preacetabular ilia rise above the ridge formed by the neural arches of the vertebræ, and the external intertransverse sacral foramina are almost completely filled up.

acet.=acetabulum. *p.*=pubis.
ant.tr.=antitrochanter. *p.-a.il.*=preacetabular ilium.
il.-is.n.=ilio-ischiadic notch. *pt.-a.il.*=postacetabular ilium.

from another, and do not rise above the synsacrum. The peculiar form of this pelvis bears a striking resemblance to that of

certain Steganopodes. The resemblance is perplexing, and would seem to suggest that it is from this more primitive stock that the Falconiformes, in common with the Ciconiæ, have been derived: the Ciconiine characters of the Falconiform skeleton, already alluded to, being homoplastic. On the whole, however, I feel, at present, inclined to adopt the Gruine origin of the Falconiformes, suggested by Beddard. *Cathartes* and *Catharistes* agree in that the backwardly produced spine of the ischium does not project far beyond the postacetabular ilium. The iliac pockets of the Cathartæ are conspicuous by their absence.

Text-fig. 36.



Dorsal aspect of the Pelvis of *Cathartes aura*.

This is probably a more primitive type of pelvis than that of *Pseudogryphus*, and recalls that of *Fregata* or *Phaethon*. Note that the preacetabular ilia are widely separated, lying on either side of the broad ridge formed by the vertebral neural spines, and that the intertransverse sacral foramina are large and numerous.

Additional letters.

int.for.=intertransverse sacral foramina.
n.s.=neural spines.

We now turn to the pelvic girdle of the Accipitres. Here

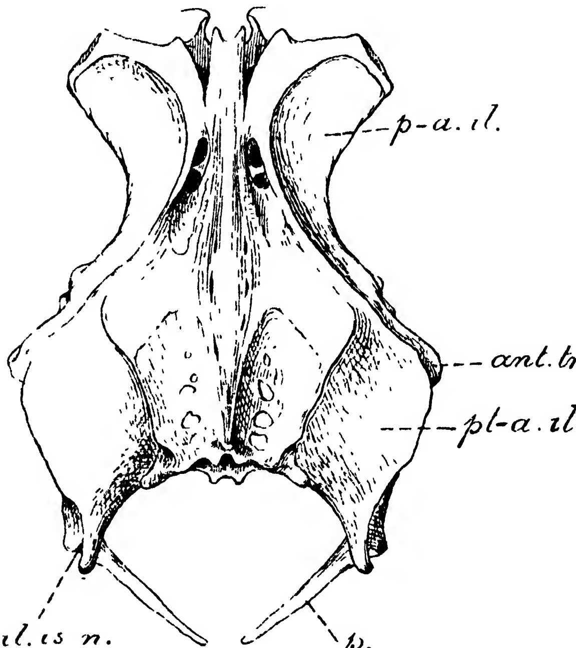
we meet with a type of pelvis found elsewhere only amongst the Striges. Its chief characteristic is the great deflection and shortening which the postacetabular ilium has undergone, and this is more marked in the Accipitrine innominate. The innominate bone of the Owls can, however, it would seem, be readily distinguished by the fact that the ischium is invariably produced backwards into a more or less slender spine resting on the pubis.

In its general conformation the pelvic girdle of the Falconiformes, after the elimination of the Gypogeranidæ and Cathartæ, is very uniform: modifications from the type are very considerable. Some of the more noticeable, however, may profitably be commented upon here. The most conspicuous departure from the type is found in the pelvis of *Pandion* (text-fig. 37, p. 305), which is remarkably broad. This great breadth is due partly to the length of the outstanding transverse processes of the synsacrum, which support the roof of the anterior and posterior renal fossæ; and partly to the exceptionally broad dorsal plane of the postacetabular ilium. The preacetabular ilium is sharply truncated anteriorly, and is widely separated from its fellow of the opposite side: so much so that a tubular aperture the *canalis ileolumbalis* -- is left at the point where the mesial curved border leaves the synsacrum. The glenoid surface of the antitrochanter is oblong in shape and curved backwards. The ilio-ischiadic foramen is of great size. The obturator foramen is also very large, and closed posteriorly by the approximation of the pubis to the inferior border of the ischium, which, we may remark, turns abruptly upwards at its hinder end. The pubis is long, and develops a crescentic plate the cephalad segment of which fits closely to the upturned ischial border; beyond this it is continued backwards for a considerable distance as a rod-shaped bar nearly meeting its fellow of the opposite side.

The pelvis of *Pandion* (text-fig. 37, p. 305) is an exaggeration of the typical Accipitrine pelvic girdle, which may be very well represented by such a form as is presented in *Polyborus* for example. Herein the pre- and postacetabular ilia are about equal in length. The former is a moderately broad concavo-convex plate directed outwards and downwards, meeting its fellow of the opposite side in the middle line, and having its superior border accentuated by a sharply-defined outstanding crest, which, in some forms, as in *Haliaëtus* and *Parabuteo* for example, becomes still more strongly accentuated, forming an almost shelf-like projection. This border is continued backwards to terminate in an overhanging supratrochanteric process. The postacetabular ilium expands into broad dorsal plates, terminating somewhat abruptly some distance from the end of the ischium, with which it is fused. In *Accipiter* and *Elanus*, and still more markedly in *Polyboroides*, the dorsal border of the ischium turns sharply inwards so that the dorsal plate of the ilium forms a relatively enormous ledge overhanging a deep cavern passing forwards into the obturator foramen. In

Aquila, *Thrasaëtus*, *Haliaetus*, *Circaëtus*, for example, the post-ilia pass insensibly backward into the ischium, instead of abruptly.

Text fig. 37.



Dorsal aspect of the Pelvis of *Pandion haliaetus*

As in the pelvis of *Cathartes*, the preacetabular ilia fail to rise above the neural spines of the vertebrae. A pair of canales ileo-lumbales are present but most of the intertransverse sacral foramina have become filled up. The great breadth of the pelvis, as shown in text-fig 36, p 303, is caused by the unusual length of the sacral ribs and transverse processes.

In the majority of Accipitres the pre- is longer, sometimes nearly twice as long, than the postacetabular ilium, which is markedly deflected.

The *ischium* is generally truncated posteriorly, but in some, as in *Thrasaetus* and *Aquila* for example, the posterior end is hastate.

The *pubis* is generally long and slender, and at the level of the end of the ischium turns abruptly inwards towards the middle line nearly meeting its fellow of the opposite side. In *Thrasaetus*, *Lophaetus*, *Parabuteo*, it is vestigial, only the proximal end remaining. This terminates immediately behind the obturator foramen, and serves to close it, often by fusion with the

ischium. In many forms, as in some species of *Falco*, *Herpetotheres*, *Elanoides*, *Elanus*, *Spilornis*, *Accipiter*, the median portion of the pubis has disappeared, the proximal portion fusing with the ischium, immediately behind the obturator foramen, whilst the distal (hinder) ends are attached to the posterior border of the ischium. Thus several grades in the degeneration of this bone are presented. Sometimes the two portions are connected by a very slender thread of bone.

The iliac recess in *Serpentarius* is spacious, and extends backwards into a pocket-shaped cavity, as in Rails. This pocket is wanting, or but feebly developed, in the other Falconiformes, except *Pandion*, but it is interesting to note that it is universally present in the Striges.

vii. The Pectoral Limb.

Not only is there little variation in the form of the wing between the different members which are included in the present group; but there is also a strong resemblance between the wing of the Falconiformes and that of the Grues on the one hand, and the Storks on the other: the resemblance to the Grues being especially marked.

The following characters displayed by the *humerus* will help in distinguishing between the wings of these three groups:—In the Falconiformes and Grues the scar marking the insertion of the pectoral muscle runs along the free border of the triangular pectoral crest from the *tuberculum externus* till it reaches the summit of the triangle, where it expands into a broad elliptical space occupying the lower limb, and, in the Cathartæ, extending on to the shaft. In the Ciconiæ the distal extremity of this scar takes the form of a strongly-raised, linguiform plate which lies partly on the shaft of the humerus and partly at the base of the distal limb of the crest; instead of occupying nearly the whole crest. The humerus of the Falconiformes may be distinguished from that of the Grues in that, in the former, the subtrochanteric fossa is larger, the distal extremity of the humerus is much wider, and its ulnar tuberosity much more prominent.

The coraco-humeral groove appears to be markedly developed only in *Pandion*. In other forms it is either indicated only by a very shallow groove, or by two depressions. The head of the humerus in the Falconiformes is more compressed from palmar to dorsal surface than in the Grues. The supra condylar depression for the brachialis inferior varies in its development. In *Pandion*, for example, it is deep with gently sloping sides; in *Gypagus* the floor is flat and oval and is bordered by a well-defined rim imperfect distally: in *Falco* and *Accipiter* again it is barely traceable; in *Serpentarius* it is an oval depression placed rather high up in the shaft. A small tubercle only, represents the ectepicondylar process. The form of the pectoral crest varies. In *Serpentarius*, *Pandion*, and Falcons it is sharply triangular, and in *Pandion*

the proximal border of this triangle is deeply hollowed. In *Accipiter* the distal border terminates abruptly. The pectoral crest is very long, extends far down the shaft, and is semicircular rather than triangular.

The relative proportions of the arm, forearm, and manus vary. Generally the manus is the shortest segment, and the forearm the longest. In *Falconinæ* and *Elanus*, for example, the manus is the longest and the humerus the shortest. But the forearm is always longer than the humerus.

The *forearm*, as a rule, shows only faint traces of tubercles marking the attachment of the quill-feathers. In Cathartæ, however, these tubercles are very strongly developed, thus recalling the ulna of the Ciconiæ. The *radius* of the Falconiformes is more nearly cylindrical than in the Grues.

The *manus*, as we have already remarked, may be longer than the humerus, it never exceeds the forearm. The third metacarpal is slender, laterally compressed, and, save in *Serpentarius*, is attached only by its extreme proximal and distal ends. The manus may on this account be more or less readily distinguished from that of the Ciconiæ or the Grues. In the members of both these groups the proximal end fuses with the second metacarpal distad of a line drawn transversely through the metacarpus at the level of the articulation for the pollex. The distal end of metacarpal III. in the Falconiformes, *Serpentarius* excepted, resembles that of the Ciconiæ, and differs, like the latter, from that of the Gruidæ and *Serpentarius*, wherein the inter-metacarpal space is lessened by the deposition of bony tissue. It is extremely difficult to distinguish the manus of the smaller Accipitres from that of the Striges of similar size. Perhaps the only character which will hold good for a large series of comparisons is that afforded by the point of fusion of the proximal end of metacarpal III. In the Owls this takes place distad of a line drawn through the metacarpus at the articulation for the pollex, as in the Ciconiæ and Grues.

The phalanges do not call for any special comment. The pollex bears a small claw. The postaxial border of the only phalanx of digit III. has the middle of the postaxial border raised into a small tubercle.

viii. The Pelvic Limb.

The pelvic limb in all the Falconiformes, save *Serpentarius*, is shorter than the pectoral. But whilst, as in *Polyboroides*, the two limbs are nearly equal in length, in *Serpentarius* the difference is very considerable.

The femur, in all, is pneumatic, a pneumatic foramen opening on the dorsal aspect of the femur, mesiad of the base of the great trochanter—as in the Ciconiæ. The popliteal fossa is but feebly developed. The shaft is moderately long, and cylindrical.

The *tibio-tarsus* is in all more or less dorso-ventrally depressed,

and is slightly bowed forwards. The cnemial crests are not largely developed.

In *Serpentarius* they form prominent outstanding blades, not extending down the shaft but strictly confined to its proximal extremity. The ectocnemial crest is directed outwards, standing at right angles to the entocnemial. In so far as the direction of this crest is concerned, it agrees with the remaining Falconiformes, but in its greater size it stands alone. Furthermore, the shaft of the tibio tarsus is peculiar, in that it is perfectly straight and almost cylindrical, not bowed forwards and depressed as in the other Falconiformes. The tibio-tarsus thus much more closely resembles that of the Storks. Additional Stork-like characters are found at the distal end of the shaft in the great breadth of the extensor bridge, and in that the lateral borders of the posterior trochlear surface are produced backwards and upwards into a pair of prominent ridges. But there is no intercondylar tubercle, and no depression below the extensor bridge. The trochleæ are not laterally compressed, but separated by a wide and deep gorge. There is a conspicuous entocondylar tubercle. The fibular crest is but feebly developed, but the fibula extends down to the lower third of the shaft.

The tibio-tarsus of the Cathartæ is much more Accipitrine in character. The fibular crest is prominent. The extensor bridge is wide, oblique, placed nearer the inner border of the shaft, and somewhat more superficial than in the other Falconiformes.

In the Falconidæ and Buteonidæ there is not much difference, save in minor points, some of which, however, are extremely helpful for diagnostic purposes.

Take the Falconidæ for example. In *Herpetotheres*, immediately above the outer tibial condyle, and lateral of the extensor bridge, is a shallow pit. This, in *Polyborus*, becomes pierced by a small foramen opening inwards into the extensor groove. In the remaining Falcons (*Herpetotheres* being the exception) and in *Milvago* this small foramen has increased to an aperture as large as that below the extensor bridge. Thus there appears to be two extensor bridges, one above each condyle. Apart from size, the tibio tarsus of *Herpetotheres* can easily be distinguished from that of *Polyborus* by the fact that in the latter the bridge is wider and the intercondylar gorge is narrower and deeper.

In the Buteonidæ the most aberrant tibio-tarsus is that of *Pandion*. One of its most striking characters is the extreme depth and width of the extensor groove, which is so deep that it is saved from perforating the shaft only by a very delicate plate of bone. The fibula extends to within a short distance of the tarsal segment, and is very large. The fibular ridge is placed somewhat lower down the shaft than usual. The distal end of the shaft, above the extensor bridge, is wider than across the condyles, which are laterally compressed.

It is a point of considerable interest to notice that the extensor groove in the Striges is barely perceptible in the Barn-Owls,

deep in the remaining forms, whilst the ossified extensor bridge is conspicuous by its absence. The absence of this bridge should surely be as valuable a piece of evidence that *Pandion* is *not* related to the Striges, as is the presence of an extensor bridge on the tarso-metatarsus to show that it *is* so related! Furthermore, we may remark that this tarso-metatarsal bridge is wanting in the Barn Owls, so that the value of this character is still further weakened.

The tibio-tarsus of *Polyboroides* is, in its way, almost as remarkable as that of *Pandion*. It is long and almost of the same thickness throughout. As in *Pandion*, the width of the shaft immediately above the distal condyles is greater than across the condyles themselves. This is probably due to the fusion with the shaft of the distal end of the fibula which extends down to the tarsal elements—though, as just indicated, fused with the shaft. The extensor bridge is placed transversely across the shaft. The tibial condyles are but feebly developed, the ectocondyle barely projecting beyond the shaft. The intercondylar gorge is wide.

The lower third of the shaft of the larger Accipitres is dorso ventrally depressed. There is often an additional and well-defined fibular bridge. The second lies some distance below the first, and affords attachment for the distal end of the fibula. The cnemial crests are relatively but slightly developed. In *Aquila*, perhaps, they reach the maximum development, the entocnemial crest being unusually strong. In *Thrasaetus* the ecto- and entocnemial condyles are conspicuously wide apart, causing the inner border of the shaft to have a very marked curve.

The *fibula*, as a rule, tapers to a fine point, and terminates near the lower third of the tibial shaft, sometimes fusing therewith. In *Pandion*, *Polyboroides*, and *Pernis* only is it of almost uniform thickness and continued downwards as far as the tarsal elements.

The *tarso-metatarsus* varies extremely, both in its relative length and in the development of bony matter for the mechanical requirements of the limb.

In *Serpentarius* only is the tarso-metatarsus as long as the tibial shaft. In *Accipiter*, however, it is very nearly so. Generally it is shorter than the femur.

The hypotarsus is simple in all save *Pandion* and *Pernis*, wherein it forms a tube.

The distal trochleæ, save in *Serpentarius* and Cathartæ and in *Leptodon*, are all on the same level. In the two first-mentioned exceptions the middle trochlea is produced somewhat beyond the level of the others. In *Leptodon* the inner trochlea is the longest, the middle slightly shorter, and the outer shorter still, so that an obliquely sloping series is formed. The plane of the trochleæ forms a slight and regular curve, except in *Pandion*, in which this curve is very strong; and *Polyboroides*, in which the 2nd and 3rd trochleæ lie close together, whilst the 1st is bent downwards so

that the dorsum of the trochlea lies almost behind the level of the 2nd and 3rd. The regularity of the curve is thus broken.

Usually the outer and inner trochleæ are produced backwards into spur-like processes, that of the outer trochlea being directed backwards, whilst the inner slopes obliquely outwards and backwards away from the shaft. In some few cases, as in *Leptodon* for example, these spurs are barely perceptible.

In *Sepentarius*, the Cathartæ, and the Falconidæ the hypotarsus takes the form of a strong median keel. But whereas in the two former the keel is grooved equally on either side, and terminates above in a more or less quadrangular table; in the latter it is much more deeply grooved externally, and terminates above as a thin vertical plate with a flanged free border. The front of the tarso-metatarsus in *Serpentarius* and Cathartæ is deeply grooved. In the former are two distinct raised surfaces for the tibialis anticus, in the latter only one. Immediately above the surface for attachment of the tibialis anticus are two foramina, large in the Cathartæ, small in *Serpentarius*.

In the Falconidæ the anterior tarso-metatarsal groove is shallow, the foramina are small, and there is but a single raised process for the tibialis anticus, which lies on the inner side of the shaft.

In the other Accipitres the hypotarsus takes the form of two more or less prominent spurs separated by a wide groove. The inner spur is generally somewhere near the middle line of the shaft, but in *Elanus* it springs from the inner border of the shaft.

The shaft of the tarso-metatarsus is very variable in form. In *Serpentarius* it is long and cylindrical, but with the inner aspect grooved, but in the majority of the Accipitres it is more or less dorso-ventrally flattened and twisted into long and broad ledges and plates; thus adding exceedingly to its power. These features are most marked in *Thrasaëtus*, which in section is seen to be almost ¬-shaped. The same is true of *Aquila*, *Haliaëtus*, *Parabuteo*, *Busarellus*, *Antenor*, *Urubitinga*, and *Helotarsus*, for example, but to a lesser extent. In forms such as *Gypohierax* and *Gypaëtus* the shaft is much less markedly modified, and this accords well with their habits. *Polyboroides* has a peculiar shaft. This, as we have previously remarked, is long, much flattened antero-posteriorly, and deeply grooved behind: its outer border is flattened out into a relatively broad plate, so that in section the shaft resembles that of *Thrasaëtus* without the lateral torsion.

The phalanges are also characteristic. In *Serpentarius* the ungual phalanges are large but not remarkably so. Ph. 1, 2 of digit II. are subequal; ph. 2, 3, digit III. are shorter than ph. 1; ph. 3 and 4, dig. IV. are much reduced.

In Cathartæ ph. 1 of the hallux is very long; the phalanges of digits II., III. are also relatively much longer than in *Serpentarius* or the Accipitres. The phalanges 2, 3 of dig. IV. are also longer, relatively, than in other Falconiformes.

In the Falconidæ ph. 1 of dig. II. is considerably shorter than

ph. 2, but not so much as in the other *Buteoninæ*. Similarly ph. 2 of dig. III. and ph. 2, 3 of dig. IV. are relatively much longer than in the latter group.

In the Buteonidæ ph. 1 of dig. II. is very short and often fused with ph. 2, as in *Haliaëtus* for example: ph. 2, dig. III. is generally much shorter than ph. 1 and 3: ph. 3, 4, dig. IV. are always very short. In *Elanus* ph. 3 is reduced to a vestigial condition.

In *Accipiter* ph. 2, dig. III. is not shortened: in *Elanus* it is exceedingly so. Again, in *Accipiter* ph. 2, 3, dig. IV., though obviously shortened, are not nearly so much so as is usually the case among the Accipitres. The numerous variations of this character are useful generic characters, and will be found in the keys which it is proposed to add to this paper.

It is interesting to note that the foot of the Striges in the matter of proportionate lengths of the phalanges resembles the Buteonine section of the Accipitres.

ix. Summary.

Adaptation to a raptorial mode of life has so profoundly modified the skeleton of the Falconiformes that much of the evidence concerning the origin of the group has been defaced or obscured.

The most aberrant members of the group are the Cathartæ. So markedly do these differ from the other Accipitrine forms that authorities of no less weight than Garrod and Forbes, for instance, regarded them as an Order apart therefrom. Thus Garrod placed them with the Ciconiæ and Steganopodes, and Forbes with the Ciconiæ and Tubinares. This was based on a study of the anatomy of the soft parts plantar tendons, thigh- and wing-muscles, and trachea, and on the vestigial condition of the cæca, and in all these particulars the group is undoubtedly Stork-like.

Mr. Beddard, however, has recently[1] expressed his belief in the derivation of the Falconiformes from a Gruine stem, and has furthermore brought forward some convincing evidence in support of his views. The Stork-like characters of the Falconiformes are possibly to be traced from their origin low down on the Gruine stem before the characters common to the diverging branches of Storks and Cranes began to undergo transformation.

Osteologically, the Falconiformes are certainly more Gruine than Ciconiine, and here the character most to be depended upon is found in the skull. It is a comparatively small point, at first sight, yet it explains the apparently wide differences which separate the skull of the Cathartæ, not only from that of all the other Falconiformes, but from that of all other members of the Class Aves.

The Cathartæ, it will be remembered, have a desmognathous palate of a quite peculiar type, the maxillo-palatine processes

[1] Structure and Classification of Birds. 1898.

being much reduced and widely separated, but, nevertheless, bridging the palate; and this by means of a pair of strap-shaped processes, arising from their inner dorsal borders, and extending mesially to meet a horizontally expanded plate developed by the inferior border of the ossified hinder end of the nasal septum. These processes—the anterior septo-maxillary spurs of Parker—feebly developed in *Rhinochætus* and *Tetrapteryx*, are well seen in *Psophia* (Pl. XXXIII. fig. 8); and Mr. Beddard was, I believe, the first to point out their homologies and the part they play in the formation of the peculiar palate of the Cathartæ. Thus, in describing the palate of *Psophia* he says, "If these processes were to be increased in size and to meet a bony internasal septum, we should have the 'desmognathous' skull of the American Vultures." It is possible, that at the time Mr. Beddard did not quite grasp how nearly the Psophiine skull approached the realization of the modifications peculiar to the Cathartæ, since I gather—from his silence on the point—that there was no trace of an ossified nasal septum in the skull or skulls which he examined. In all the skeletons at the Natural History Museum, save one, there is no septum, which has apparently been lost in maceration. In this one, it takes the form of a greatly fenestrated plate tapering forwards to a point, and terminating at the distal fourth of the external nares. The fenestration in this species is so extensive that only the hinder end and dorsal border are left, but the hinder end dips downwards so as nearly to touch the maxillo-palatine processes. If this septum developed a horizontal plate, as in the Cathartæ, we should have the same type of desmognathism which is now peculiar to the last-named group.

The nasal septum of the Cathartæ is more reduced anteriorly than in *Psophia*, never extending forwards beyond the posterior third of the external narial aperture (in the skeleton), and in some genera is not even visible on a side view of the skull. In *Pseudogryphus* and *Cathariste*s it may be studied to best advantage. In the former it extends nearly as far as the middle of the narial aperture, and is fenestrated much as in *Psophia*. The bony tissue which in *Pseudogryphus* forms the anterior border of the fenestra is wanting in *Catharistes*, so that the septum is invisible when the skull is seen from the side, but, when viewed from below, the sutures between the horizontal plate of the nasal septum and the septo-maxillary spurs are plainly visible.

Mr. Beddard, in pointing out the nature of the Cathartine palate, and the probable source from which it was derived, has given us the key to a very important problem—the origin of the Falconiform stem. The Cathartæ are the least specialized members of the group, and, it is interesting to note, are also New World forms like *Psophia*. But the low generalized position of the Cathartæ is shown as well by other portions of the skeleton as by the skull. We may, I think, safely regard the Cathartæ as the most primitive of the Falconiformes.

The importance of a correct understanding of the evolution of

the Falconiform palate must be our justification for pursuing this matter a little further.

The palate of the Cathartæ is undoubtedly of an extremely specialized type, but traces of a like modification are not wanting in a direction where hitherto they have not been looked for—to wit, in the Accipitres proper.

The palate of *Elanus*, as we have already described, is schizognathous, a fact first pointed out by Shufeldt; but the schizognathism is of a specialized character, being due to the extreme reduction of the maxillo-palatine processes. If the nasal septum in the skull of *Elanus* be examined, it will first of all be remarked that it is more complete than in the Cathartæ, and next that, near its posterior inferior angle, it gives off a pair of small horizontal processes, resembling those of Cathartæ, but relatively smaller; these almost touch the maxillo-palatines. A little increase in the size of these spurs, and the reduction of the anterior portion of the septum would give us the Cathartine palate. Thus, then, the palate of *Elanus* must be held to represent the high-water mark of specialization in the direction of schizognathism in the Accipitres.

It is probable that the palate of *Circaëtus*—or rather the maxillo-palatines—represents the intermediate type from which the extremes of schizog- and desmognathism in the group have been derived. Furthermore, it may profitably be compared with the palæognathine maxillo-palatine of, say, the Tinamous. It must be remembered that the great feature of the palæognathine palate is the enormous size of the maxillo-palatines. In the highly specialized *Tinamus* this is much reduced, and in general shape is not unlike that of *Circaëtus*, but lacks its vertical plate of spongy tissue. It is important that the intermediate character of the palate of *Circaëtus* should be recognized, otherwise we commit ourselves to the admission that the desmognathous palate of forms like the Falconidæ or *Aquila*, for example, were developed by the resuscitation of an almost defunct organ. In *Circaëtus*, then, the maxillo-palatines are represented by a pair of vertical plates of spongy tissue nearly meeting in the mid-ventral line. They run backwards nearly as far as the antorbital plate (prefrontal); and forwards, then inwards towards the tomium, so as to leave a palatal vacuity exposing the nasal septum as in *Elanus*. Reduction of this type of maxillo-palatine gives us the highly specialized type of *Elanus*, its further increase the type seen in the Falconidæ, notably through *Milvago* to *Polyborus* and *Ibycter* (Pl. XXXIII. figs. 3, 5), wherein the maxillo-palatines have attained a relatively enormous size. In the *Falconinæ* we meet with an exactly parallel series, passing through *Harpa* to *Herpetotheres* (Pl. XXXIII. figs. 2–4). In the higher Falcons an increase in size of the anterior nasal chamber, eventually, in *Falco*, developing into a much inflated ossified bulla, has brought about a considerable reduction in the size of the maxillo-palatine processes; the fenestrated bullæ, seen in such perfection in

Herpetotheres, are now reduced to quite vestigial proportions, the various stages in this reduction being readily traceable through *Cerchneis* and *Hierofalco* (Pl. XXXIII. fig. 1) to *Falco*.

For further evidence, or rather clues, as to the origin of the Falconiformes—from an osteological standpoint—one would turn naturally, to the Serpentariidæ. In so far as the skull is concerned, this would prove disappointing. In its general character it certainly resembles that of *Cariama*, but in details it is thoroughly Accipitrine. The ventral view of the palate resembles that of *Aquila*; whilst in the form of the maxillo-palatine processes, especially with regard to the great size of the antrum of Highmore, it approaches *Leucopternis*, *Antenor*, and *Parabuteo*. The palate is indirectly desmognathous. The maxillo-palatines are separated only by a mere chink, and the desmognathism is effected by the ossified nasal septum, fusing with the dorsal aspect of the maxillo-palatines. In the presence of functional basipterygoid processes it differs from all the Falconiformes save the Cathartidæ. In the trunk skeleton we have already pointed out many Ciconiine characters, which are not difficult to account for if, as Beddard and others hold, the Ciconiidæ and Gruidæ may claim a community of descent.

It is certain that the evidence of the skeleton, supported by the facts which have come to light concerning the myology and other soft parts, demands that the Cathartidæ and Serpentariidæ must be included with the Falconiformes, though representing, each, a distinct sub-order. With the Striges the reverse is the case. Strikingly similar as is the skeleton of the Owls, in many characters, to that of the Accipitres, it is nevertheless certain that the nearest allies of this group must be sought among the "Picarian" birds. On osteological evidence alone, however, it is doubtful whether the Striges would ever have been separated from the Accipitres. The anatomy of the soft parts, however, seems to prove conclusively the justice of this separation. The osteological resemblances must be regarded as homoplastic—or, as some would have it, probably, kinetogenetic.

The relation which the Cathartidæ, Serpentariidæ, and Striges, severally, bear one to another and to the Accipitres proper, having now been briefly summarized, we may pass on to the discussion of the inter-relationships of the last-mentioned group.

This exceedingly difficult problem has lately been attacked by Dr. Suschkin. The main results of his study have already appeared[1 2 3], and, from what he has foreshadowed, it is not too much to say that his complete Monograph will prove one of the most valuable and complete contributions to the osteology of Birds ever published.

[1] "Beiträge zur Classification des Tagraubvögel mit zugrundelegung des osteologischen Merkmale." Zool. Anzeig. xxii. 1899.

[2] "Systematische Ergebnisse osteologisches Untersuchungen einiger Tagraubvögel." Zool. Anzeig. Bd. xxiii. 1900.

[3] "Weitere systematische Ergebnisse vergleichendosteologisches Untersuchungen der Tagraubvögel." Zool. Anzeig. Bd. xxiii. 1900.

My study of this group has convinced me of the soundness of Dr. Suschkin's conclusions, as published in the papers to which I have just referred. But whilst his investigations have extended over a period of about five years, mine have been limited to a few months. For this reason I withhold for the present the keys to the genera, such as have been included in my former papers. I hope to complete these at a later date.

Before the publication of Dr. Suschkin's papers I had already arrived at the same conclusions as are therein expressed with regard to the position of the Falcones and Polybori, and of *Gypaëtus* and *Gypohierax*. With regard to *Pandion*, though I felt certain it had nothing to do with the Striges, I had not yet discovered any further clue as to its real affinities.

What follows is practically an embodiment of Dr. Suschkin's views *in toto*: where I have had to interpret him, that is to say where I have endeavoured to express what I believe to have been his views, I hope I have done him justice.

The sub-order, then, of the Accipitres is divided into two Families, the Falconidæ and the Buteonidæ.

The family Falconidæ is to be divided into two sub-families: (1) the *Falconinæ*, (2) the *Polyborinæ*.

The former includes the genera *Harpa*, *Herpetotheres*, *Micrastur*, *Microhierax*, *Poliohierax*, *Tinnunculus*, *Hypotriorchis*, *Hierofalco*, and *Falco*.

The sub-family Polyborinæ embraces the genera *Milvago*, *Senex*, *Phalcobænus*, and *Polyborus*.

The family Buteonidæ is divided into some eleven or twelve sub-families, though on this point I am not quite clear, as Suschkin has not definitely expressed himself on this point. But he would apparently recognize the following: *Elaninæ*, *Perninæ*, *Milvinæ*, *Aquilinæ*, *Thrasaetinæ*, *Vulturinæ*, *Circaëtinæ*, *Polyborinæ*, *Circinæ*, *Urubitinginæ*, *Buteoninæ*, and *Accipitrinæ*.

In the Elaninæ are included *Elanus* and *Machærhamphus*. In the Perninæ, *Pernis*, *Baza*, *Elanoides*, *Leptodon*, and *Pandion*. But from views he expressed in conversation, he would, I suspect, probably make a separate sub-family for *Pandion*—Pandioninæ; and most, I think, will feel this advisable.

The Milvinæ include *Milvus*, *Haliastur*, and *Haliaëtus*, with, apparently, *Ictinia*, *Rostrhamus*, and *Polioaëtus*. *Haliaëtus*, there can be little doubt, has nothing to do with the Eagles. *Polioaëtus* Suschkin shows to be undeniably distinct from *Pandion*. The plantar tendons, as he proved, by a dissection made in this Museum, are of the Accipitrine type: the skeleton in no way resembles that of *Pandion*; on the contrary, the pelvis and breast-bone, so characteristic in *Pandion*, bear a quite extraordinary resemblance to those of *Haliaëtus*. The outer toe is not more reversible than in ordinary Accipitres. *Haliaëtus*, *Thalassaëtus*, and *Polioaëtus* might well be made to form a separate sub-family, *Haliaëtinæ*.

The sub-family Aquilinæ includes *Aquila*, *Uroaëtus*, *Spizaëtus*, *Nisaëtus*, and *Lophoaëtus*. The Thrasaëtinæ contain *Morphnus* and *Thrasaëtus*.

This brings us to the Vulturinæ. By most, this sub-family is regarded as of more importance than is allowed in the present scheme: Gadow and Sharpe, for example, according it the rank of a family. That the Vultures have undergone a considerable amount of specialization there can be no doubt; but it seems equally certain that they are not far removed from the *Circaëtinæ*. Suschkin recognizes evidence of two distinct branches in this family—*Gypohierax* standing at the base of one, and leading to *Neophron* and *Gyps*; *Gypaëtus* at the base of the other, and leading to *Vultur* and *Otogyps*.

The Circaëtinæ include *Circaëtus*, *Geranospizias*, *Helotarsus*, and *Spilornis*. Closely allied, and intermediate between it and the next sub-family—the Circinæ—comes the highly specialized Polyborinæ. It seems to me that this sub-family might perhaps as well be included in the Circinæ, with which, as Dr. Suschkin shows, it has many characters in common, and in this I can confirm him.

The Circinæ embrace *Circus*, *Geranospizias*, *Urotriorchis*, and *Strigiceps*.

The Urubitinginæ I have added on my own responsibility. Dr. Suschkin speaks of them as isolated forms related to the *Circaëtinæ*.

The Buteoninæ include *Buteo*, *Archibuteo*, *Tachytriorchis*, *Geranoaëtus*, *Rupornis*, *Leucopternis*, and apparently *Busarellus*, *Butastur*, *Antenor*, and *Asturinula*.

In the Accipitrinæ Dr. Suschkin includes *Accipiter*, *Astur*, *Melierax*, *Urospizias*, *Lophospizias*, *Scelospizias*, and *Nisoides*.

Though we cannot regard this scheme as final, yet, it must be admitted, it is one which is in many respects an advance upon previous arrangements of this most difficult of groups. In its construction an attempt has been made to follow the lines of phylogenetic descent, the only satisfactory basis of classification, yet a peculiarly difficult one in all questions of avian descent, owing to the lack of annectant fossil forms.

Finally, it is to be noted, the Falconiformes are by no means so uniformly desmognathous as is generally supposed. Mr. Beddard has given several exceptional cases, and in the present paper the list is further extended. But it seems clear that both desmognathous and schizognathous palates are to be regarded as modifications of a Gruine-schizognathous type. The Cathartæ have transformed the peculiarities of this type into the unique desmognathism already described. The forms which still retain a schizognathous palate have slightly modified the peculiarities of the original form by loss of the septo-maxillary spurs. Further specialization has resulted in the reduction of the maxillo-palatines to the vanishing point, e. g. *Elanus*. But the majority of the Falconiformes have greatly increased the size of the maxillo-palatines till they meet in the middle line (*a*) embracing the nasal septum between them (indirect desmognathism), or (*b*) meet beneath the septum fusing with one another (complete desmo-

gnathism). The various transitional schizognathous types which occur with considerable frequency, and sporadically, indicate the steps by which these two forms of desmognathism have been acquired.

The presence of the hemipterygoid element in all save the Falcons is a point of considerable interest, serving not only as an additional index of the high degree of specialization which the family has undergone, but also to show how a character common to the members of several widely different orders has been independently acquired by the modification of a common plan of structure.

As I have recently pointed out, the Neognathine (Carinate) palate has been derived directly from the dromæognathous found only in the Palæognathæ. The movement of the palatines towards the mid-ventral line, whereby they come to underlie the distal ends of the pterygoids, has caused the latter to segment and the formation of a pseudo palato-pterygoid joint. The segmentation of the pterygoids and the fusion of the distal segments thereof with the palatines relieved them from their function of supporting the vomer and threw the work upon the palatines. As a consequence atrophy of the hemipterygoid ensued: indeed, in all the members of some sub-orders, *e. g.* Anseres, Galli, and in the Falcones, it has been entirely suppressed. When present, save in a few exceptional cases, it has lost all actual connection with the vomer, which is borne entirely by the palatines.

The evolution of the Neognathine palate has effected the following changes:—

1. A shortening of the pterygoids, by the segmentation of their distal ends and the fusion thereof with the palatines.

2. A lengthening of the palatines, by their forward growth beneath the maxillo-palatine processes, with which they originally united, to effect a union with the premaxilla; and a change in their position by the movement inwards to meet in the mid-ventral line.

3. A reduction in the size of the vomer, resulting frequently in its complete suppression.

But besides changes of position in their relative lengths, the pterygoids have also undergone a change of function, since these bones now serve as mere backward extensions of the palatines, their original function, the support of the vomer, being transferred as aforesaid to the palatines.

Similarly, the palatines have assumed new functions, in addition to the support of the vomer. They occupy, functionally, with the now subordinated pterygoids, the place of the conspicuous submedian vomero-pterygoid bar of the Palæognathine skull, wherein, it will be remembered, they formed but little more than an appendix to the pterygoid.

x. Key to the Osteology of the Falconiformes.

A. Skull.

Upper jaw more or less markedly hooked; nostrils holorhinal, and when pervious, associated with functional basipterygoid processes; temporal fossæ, when present, confined to the lateral aspect of the skull; supra-orbital grooves absent; vomer blade-shaped; palate desmo- or schizognathous; an ossiculum lachrymo-palatinum is never present.

A. Palate indirectly desmognathous, being bridged by union of the septo-maxillary spurs with a horizontal plate developed by the ossified nasal septum; olfactory chamber of great size; lachrymal fused with frontal; nares pervious; basipterygoid processes functional; vomer wanting .. CATHARTÆ.

B. Palate indirectly desmognathous; basipterygoid processes functional; maxillo-palatines with an enormous antrum of Highmore; lachrymal with a very large supra-orbital process closely applied throughout its whole length to the frontal, and with its descending process reaching to the quadrato-jugal bar. SERPENTARII.

C. Palate directly or indirectly desmognathous or schizognathous; nares impervious; basipterygoid processes vestigial or wanting ACCIPITRES.

Key to the Families of the Accipitres.

A. Vomer terminating anteriorly in a more or less conspicuous olive-shaped swelling, closely applied to the maxillo-palatine processes. Palate directly desmognathous; antorbital plate (prefrontal) largely developed and with outer border closely applied to or fusing with the lachrymal; lachrymal without superciliary plate; squamosal prominence strongly developed; nostrils with a very small circular or slit-like aperture; ventral aspect of premaxilla with a median bony ridge; mandible with a ramal vacuity . Falconidæ.

B. Vomer never expanded anteriorly, and never applied to the under surface of the maxillo-palatines; palate indirectly desmognathous, or schizognathous; antorbital plate (prefrontal) generally tongue-shaped, often much reduced, or articulating, or even fusing by its free end with the distal extremity of the lachrymal; nostrils slit-like or pear-shaped, and fully exposing the nasal septum; lachrymal generally provided with a superciliary plate; squamosal prominence not greatly developed . . . Buteonidæ.

Key to the Sub-families of the Falconidæ.

A. Supra-orbital process of lachrymal extending backwards beyond middle of orbit; temporal fossa heart-shaped . . . . *Falconinæ.*

B. Supra-orbital process of lachrymal not extending as far as the middle of the orbit; temporal fossa elliptical . . . . *Polyborinæ.*

B. Sternum and Pectoral Girdle.

Corpus sterni very large, relatively to the size of the girdle, oblong, and with relatively small anterior lateral processes which bear facets for the articulation of the anterior sternal ribs; posterior border entire, notched or fenestrated, but the posterior lateral processes are never very large; articular surfaces for sternal ribs extend up to or beyond the middle of the sternal plate; coracoid grooves wide, but shallow, and bordered above by a well-marked "lip"; coracoids slightly overlapping or only touching one another, and with a well-marked *processus lateralis basalis*; acrocoracoid very large; furcula U-shaped and very broad, with a feebly developed hypocleideum.

A. Corpus sterni with metasternum produced into a point, bounded by a pair of notches; furcula articulating with the antero-inferior angle of keel; acrocoracoid not affording an articular surface for furcula ...... SERPENTARII.

B. Corpus sterni with posterior border with two pairs of notches, the outer pair sometimes becoming closed to form fenestræ; keel very deep, extending backwards to extreme end of sternum; coracoid grooves divided from one another in the middle by a strong ridge; acrocoracoid without articular facets for furcula. CATHARTÆ.

C. Corpus sterni with posterior border notched, fenestrated, or entire; coracoid grooves overlapping; acrocoracoid with well-marked facet for articulation of furcula . . . . ACCIPITRES.

Key to Families of the Accipitres.

A. Spina externa and interna well developed; procoracoid large, articulating with clavicle .. FALCONIDÆ.

B. Spina externa only present; procoracoid articulating with scapula only and widely separated from clavicle . .. ACCIPITRIDÆ.

C. PELVIC GIRDLE.

Praeacetabular ilium very long and with the external lateral border more or less markedly concave; pectineal process wanting; supra-trochanteric processes generally prominent and raised high above anti-trochanter; pubis, when present, generally closely approximated to the ventral border of the ischium.

A. Postacetabular ilium shorter than ischium, but without a notch indicating the two elements posteriorly SERPENTARII.

B. Postacetabular ilium shorter than ischium, and the limitations of the two elements indicated posteriorly by a deep notch, the ischium being continued backwards as a sharp spine along the pubis; pubis projecting far beyond ischium. CATHARTÆ.

C. Postacetabular ilium shorter than ischium, and much deflected; ischium never produced backwards into a spine; pubis often vestigial ACCIPITRES.

XI. EXPLANATION OF THE PLATES.

PLATE XXXI.

Ventral Aspect of the Skull.

Fig. 1. Skull of *Cathanistes urubu*, showing the type of desmognathism peculiar to the Cathartæ, wherein the palate is bridged by the union of the horizontal plate of the nasal septum with a pair of septo-maxillary spurs. Note also the presence of basipterygoid processes.

Fig. 2. Skull of *Elanus cæruleus*. The palate is schizognathous. Herein the maxillo-palatines have increased in size, whilst the septo-maxillary spurs have completely disappeared. The nasal septum is more complete than in *Catharistes* and may be seen lying in the middle line of the anterior palatal vacuity. Above the inflated region of the maxillo-palatines it sends downwards a feeble pair of spurs which nearly touch the maxillo-palatines. The basipterygoid processes are represented only by a pair of minute prickles.

Fig. 3 Skull of *Falco minor*. The palate is completely desmognathous. Note the peculiar form of the vomer, and its relation to the maxillo-palatines. The antrum of the maxillo-palatines is reduced to the merest vestige.

Fig. 4. Skull of *Circaetus gallicus*. The palate is schizognathous, and an exaggeration of that seen in *Elanus*. Fusion of the approximated maxillo-palatines and a downgrowth of and addition to the substance of the nasal septum would give the palate of *Falco*. Note the palatal aperture of the antrum.

Fig. 5. Skull of *Pseudogyps bengalensis*. The palate is indirectly desmognathous. The palate is bridged by the fusion of the greatly swollen nasal septum with the widely separated maxillo-palatines.

Fig. 6. Skull of *Gypaëtus barbatus*. The palate is indirectly desmognathous, and of the same type as in *Gyps*, but from its less specialized condition shows how the palate of *Gyps* has been derived. The vomer is present, the maxillo-palatines are of great length and widely separated, whilst the nasal septum can be traced throughout its entire length.

Fig. 7. Skull of *Serpentarius serpentarius*. The palate is schizognathous, since the maxillo-palatines, though closely approximated, do not fuse. Fusion would produce the completely desmognathous type of *Falco*. The antrum of the maxillo-palatines is of great size, and the maxillo-palatine processes are large.

Explanation of letters.

A.p.v. = anterior palatal vacuity. ***p.a.a.*** = palatal aperture of antrum.
bp.p. = basipterygoid process. ***pt.*** = pterygoid.
mx.p. = maxillo-palatine process. ***s.*** = spur of nasal septum.
n.s. = nasal septum. ***vo.*** = vomer.
p.a. = palatine.

Plate XXXII.

Fig. 1. Dorsal aspect of skull of *Catharistes urubu*, showing the absence of orbital processes to the lachrymals and the imperfect nasal hinge.

Fig. 2 Dorsal aspect of skull of *Serpentarius serpentarius*, showing the large orbital processes of the lachrymals and their relation to the frontals.

Fig. 3. Dorsal aspect of the skull of *Buteo jakal*, showing the large, outstanding orbital processes and the superciliary plate.

Fig. 4. Dorsal aspect of the skull of *Falco minor*, showing the large outstanding orbital processes of the lachrymal and the absence of a superciliary plate.

Fig. 5. Dorsal aspect of the skull of *Pandion haliaëtus*, showing the absence of orbital processes to the lachrymal. Compare this fig. with the skull of *Catharistes*, fig. 1, and note that in *Pandion* the lachrymal appears on the surface of the skull.

Fig. 6. Dorsal aspect of the skull of *Microhierax*, to show the nasal hinge.

Fig. 7. Lateral aspect of the skull of *Microhierax fringillarius*, to show the nasal hinge.

Fig. 8. Lateral aspect of the skull of *Falco minor*, to show the relation of the lachrymal to the antorbital plate (prefrontal) and the shape of the nostril.

Fig. 9. Lateral aspect of the lachrymo-nasal region of *Pandion haliaëtus*, to show the fusion of the lachrymal with the antorbital plate.

Fig. 10. Lateral aspect of the lachrymo-nasal region of *Serpentarius serpentarius*, to show the relation of the lachrymal to the antorbital plate, and the great size of the antrum of Highmore.

a.p. = antorbital plate.
l. = lachrymal.
n.h. = nasal hinge.
s. = superciliary plate.
or.l. = orbital process of lachrymal.

Plate XXXIII.

Fig. 1. Lateral view of the upper jaw of *Hierofalco gyrfalco*, showing the gradual suppression of the vertical bullate portion of the maxillo-palatine by the increasing development of the anterior olfactory chamber (vestibulum externus).

Fig. 2. Lateral view of the upper jaw of *Harpa australis*, showing the more primitive condition of the vertical bullate portion of the maxillo-palatines in the *Falconinæ*.

Fig. 3. Lateral view of the upper jaw of *Milvago chimachima*, showing the more primitive condition of the bullate portion of the maxillo-palatines in the *Polyborinæ*.

Fig. 4. Lateral view of the upper jaw of *Herpetotheres cachinnans*, showing the maximum development of the bullate portion of the maxillo-palatines reached by the *Falconinæ*.

Fig. 5. Lateral view of the upper jaw of *Ibycter ater*, showing the maximum development of the bullate portion of the maxillo-palatines reached by the *Falconinæ*.

Fig. 6. Dorsal aspect of the palatal bones of a young *Pernis apivorus*, to show the hemipterygoids.

Fig. 7. Lateral view of the palatal bones of a young *Pernis apivorus*, to show the relation of the hemipterygoid to the vomer.

Fig. 8. Lateral view of the lachrymo-nasal region of the skull of *Psophia*, after removal of the lachrymal and part of nasal, to show the septo-maxillary spurs and their relation to the maxillo-palatines and nasal septum.

h.pt. = hemipterygoid.
mx.p. = maxillo-palatine.
n.s. = nasal septum.
v.e. = vestibulum externus.
vo. = vomer.

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THE END.

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May 6, 1902.

Prof. G. B. Howes, LL.D., F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions made to the Society's Menagerie in April 1902:—

The registered additions to the Society's Menagerie during the month of April were 208 in number. Of these 19 were acquired by presentation, 45 by purchase, 19 were born in the Gardens, and 125 were received on deposit. The total number of departures during the same period, by death and removals, was 139.

Amongst the additions are the first examples that we have received of the beautiful Grey Teal (*Querquedula versicolor*) of the Argentine Republic, obtained by purchase at the Antwerp sale.

The Secretary called attention to a specimen of Moth of the genus *Cossus*, which had been sent home in chrysalis by Mr. W. L. Sclater, F.Z.S., from the Cape (Feb. 27th, 1901), and had emerged in the Insect-house, as mentioned by Mr. A. Thomson in his Report (P. Z. S. 1902, vol. i. p. 204). Mr. Sclater had sub-

mitted this specimen to Mr. R. Trimen, F.R.S., who had favoured him with the following remarks upon it:—

"On comparison of the specimen with the series in the British Museum, there can be no doubt at all that it is a veritable *Cossus ligniperda*, or 'Goat-Moth.'

"It would be interesting to know the history of this example, for there can be no question that timber-burrowers are carried about the world more than most insects, and it seems possible that the larva of this *Cossus* may have travelled in logs to the Cape, and been developed there, and so been sent home as a South-African insect.

"It is also not altogether unlikely that the species may have been introduced into South Africa and have established itself there, as it feeds on several different trees, and the willow (one of its food-trees in Europe) is represented by a closely-allied *Salix* in South Africa."

The following papers were read:

1. On the Mammals collected during the Whitaker Expedition to Tripoli. By OLDFIELD THOMAS.

[Received March 26, 1902.]

(Plate I.[1])

Mr. J. I. S. Whitaker, F.Z.S., who has already done so much for the exploration of the Vertebrate Fauna of Northern Africa, and to whom our National Museum is indebted for important collections of Mammals from Sicily, Tunis, and Morocco, has long wished to send a collecting expedition into the little-known country of Tripoli. Last year, by the kind intervention of the Foreign Office, permission was obtained from the Sultan for Mr. Edward Dodson and a companion, Mr. Drake, to travel through that country, collecting specimens, and it is the Mammalian results of this expedition of which the present paper gives an account.

The expedition was carried out entirely at Mr. Whitaker's expense, and, as in the case of the previous Moroccan expedition, he has generously presented the great majority of the Mammals collected to the National Museum, to which they form a most valuable addition.

As so often happens in such cases, the material available for comparison with the Tripoli collection is most imperfect, and badly needs supplementing by specimens collected in modern fashion. Indeed, of Barbary Mammals the only modern specimens are those of Mr. Eaton from Biskra, and Mr. Dodson's own previous collections from Morocco. Zoologists, therefore, who spend their winters in the south would do a great service to

[1] For explanation of the Plate, see p. 13.

Science and the Museum if they would collect any mammals, however common, at the places they go to.

Mr. Dodson left the town of Tripoli on April 2nd, 1901, and travelled southwards by way of Sokna to Murzuk, then returned to Sokna, and from there travelled north-eastwards to the Syrt district, where he worked eastwards along the coast to Ben-Ghazi.

His localities are thus divisible into four groups, as follows:—

I. Inland country north of Sokna. March 1901 and middle of June to middle of July. Specimens collected at Tarhuna, Wadi Sofedjin, W.[1] Nefed; W. Bey; Bonjem; Erdeul; Ain Hammam; W. Titti; W. Agarib; W. Wagis; Oumsinerma; Limhursuk; Gebel Binsertia.

This is a desert region, without marked elevations; interspersed with small oases.

II. Soda Mountain district just south of Sokna (28° 55′ N., 16° 15′ E.). Beginning of May and second week of June. *Localities.* Tamari-Ferdjan; W. Sultan; Getefa; Linzerat.

The Soda Mountains rise to about 3000 ft. above the general level of the plain, not high enough therefore to have any noticeable climatic or faunal peculiarity. There is a map of this distinct in Rohlfs's 'Kufra' (1881).

III. Level and descending country southwards to Murzuk (sea-level or below). *Localities.* Shup; Oum el Abid; Zighen; Sebha; Ghodua; Murzuk.

IV. Coast district eastwards from Syrt towards Ben Ghazi. End of July and beginning of August. W. Aggar; Eleusher; Bon Cheifa; Sidi Sweya; Sidi Faradje.

From a geographical standpoint, therefore, the region traversed is of a very good representative character. But, zoologically, there must be many more species which, on account of the hurried nature of the march, and the difficulties in collecting in so wild and semi-hostile a country, must have been missed by Mr. Dodson's party. Indeed, under the circumstances it is surprising how admirable a collection has been made.

As might be expected from the position of Tripoli between Egypt and Algeria, and the homogeneous nature of all three regions, the mammals have no marked general affinity or peculiarity. Some, such as *Acomys*, *Gerbillus pyramidum*, *G. eatoni*, and *Dipodillus rivax*, are Egyptian in affinity; and others, notably the *Ctenodactylus*, are distinctly Algerian; but these affinities are evidently only the eastward and westward extensions, hitherto unknown, of Algerian and Egyptian forms, and there seems to be no special faunal relationship with either of the two countries more than the other.

The proportionate number of new forms in the collection is remarkable, the most notable being the *Ctenodactylus* and the fine Hare which I have named in honour of Mr. Whitaker, to whose enterprise and generosity the expedition is due, and who is to be congratulated on its very successful outcome.

[1] W. = Wadi

1. PIPISTRELLUS DESERTI, sp. n.

71. ♂. Mursuk. 30/5/1.

A small buff-coloured desert ally of *P. kuhli*, with a particularly small skull.

Size smaller than *P. kuhli*, but the forearm-length not so much less than in that form as to be in proportion with the much smaller skull. General structure, of ears, wings, and dentition, as in *P. kuhli*. Ears and tragus pale transparent buffy, little darker than the general colour. Wings dark brown, the usual white edging very conspicuous. Interfemoral paler brown, white posteriorly.

Colour of fur pale buffy, between cream and pinkish buff of Ridgway, strikingly different from the colour in ordinary *kuhli*. The hidden bases of the hairs dull slaty. Belly-hairs blackish slaty basally, whitish buff terminally.

Skull very small and delicate; the total length, the breadth across brain-case, and the length of the tooth-series, all conspicuously less than in *P. kuhli*, whether from Europe, Morocco, Tunis, or Egypt.

Dimensions of the type:—

Forearm 29·5 mm.

Head and body (measured in flesh) 43; tail (do.) 33; ear (do.) 10; third finger, metacarpal 29, first phalanx 10, second phalanx 8·5; lower leg and hind foot (c.u.) 22.

Skull—greatest length 11·6, median length above 10, median length below 9; interorbital breadth 4·1; intertemporal breadth 3·1; breadth of brain case 62; front of canine to back of m^3 4·3.

Type. Adult male. Original number 71.

Although with the general characters of *P. kuhli*, I do not feel justified in calling this Bat only a subspecies of that animal, for other North-African bats of this group, while tending towards *P. deserti* in colour, show no approach to its conspicuous reduction in size of skull. Examples of *P. kuhli* from Morocco (*Dodson*), Tunis (*Anderson*), and Egypt (*Anderson*), all have skulls of the full normal size.

Two names might have been thought to refer to it. Cretzschmar's *V. marginatus* from Nubia is paler in colour than usual, but Dr. Anderson's specimens show that the form from there is of the usual size.

Pipistrella minuta Loche [1], on the other hand, is so far smaller as either to be a totally different form, or, more probably, the young of some indeterminable species. Its locality is in the Algerian range of *P. kuhli*.

2. HYÆNA HYÆNA L.

43. Getefa, near Sokna. 5/5/1.

[1] Expl. Scient. Alg. p. 78 (1867).

3. CANIS sp.

Skull: "Found in ancient water-reservoir at Sidi Abdul Arbi." Probably a domestic dog.

4. VULPES sp.

Skull: "Found in old reservoir at Sidi Faradje."
This skull is not distinguishable from that of a female *V. ægyptiaca* from the Lower Nile.

5. GERBILLUS PYRAMIDUM TARABULI, subsp. n.

15. 16. 28. 31. Ain Hammam. 27/4/1 2/5/1.
35. 36. 38. 41. Tamari-Ferdjan. 5/5/1.
42. Linzerat. 7/5/1.
47. 48. 49. 51. 52. Oum el Abid. 10/5/1.
56. 57. 58. 59. Zighen. 15/5/1.
67. 69. Ghodua. 23/5/1.
64. 65. 73. 74. 75. 76. Sebha. 19/5/1-5/6/1.
89. El Koshby. 18/6/1.
91. W. Sultan. 18/6/1.
92. 95. Ferdjan. 19-20/6/1.
98. 99. 102. 103. Ain Hamman. 24/6/1.
105. 106. 107. 109. 114. W. Agarib. 29/6/1-3/7/1.
154. W. Aggar. 25/7/1.

Size, proportions, and skull as in typical *G. pyramidum* from Lower Egypt, but the colour of the upper surface uniformly bright ochraceous buff, not darker or more brownish on the back. This same bright colour is present even in the young. Post-auricular white patch conspicuous.

Dimensions of the type, measured in the flesh:—

Head and body 105 mm.; tail 149; hind foot (s.u.) 30; ear 15.

Skull—greatest length 32·7; basilar length 25; greatest breadth 17·2; nasals, length 13; interorbital breadth 6·6; diastema 9; palatal foramina 6; length of upper molar series 4.

Hab. of type. Sebha.

Type. Female. No. 76. Killed June 5, 1901.

The typical *G. pyramidum*, although its sides are bright ochraceous, has the dorsal area, at least posteriorly, darkened and more or less lined with brown. In the Tripolitan series the ochraceous covers the whole upper surface. The Nubian *G. pygargus*, on the other hand, of which the Museum has a fine series from Shendy, obtained by the Hon. N. C. Rothschild, although similar to *G. p. tarabuli* in colour, is markedly smaller, both in skull and foot.

No representative of *G. pyramidum* has as yet been found in Algeria.

6. GERBILLUS GERBILLUS Oliv.

24. 30. Ain Hammam. 28-29/4/1.
63. Attieh Louileh. 5/1.
70. Ghodua. 23/5/1.

77.78. Loumoulieh. 6 7/6/1.
80.81.82. Shup. 8–9/6/1.
101. Ain Hammam. 24/6/1.
154. W. Aggar. 25/7/1.

I can find no satisfactory distinction between these specimens and topotypes from Lower Egypt.

The Algerian representative of *G. gerbillus* is Lataste's *G. hirtipes*. A specimen in his collection—No. 1595—one of the co-types labelled by him, has the molars 1·4 mm. in breadth. Should he prove to have mixed up any other form among his rather diverse series, this skull, the length of which (28·5 mm.) was given in the original description, might be considered as the type.

7. GERBILLUS EATONI, sp. n.

113. W. Agarib. 3/7/1.
147.148.149.151. Eleusher. 24/7/1.
159. W. Aggar. 26/7/1.

A representative of the Egyptian *G. andersoni* de Wint.

General colour comparatively dark, finely lined with brown, very different to the brilliant clear tone of *G. hirtipes*. Feet short and stout, shorter than in *G. hirtipes*. Tail with its crest short, but distinctly blackened, the longest hairs about 4 mm. in length.

Skull with a larger and more rounded, bulbous, brain-case than in *G. andersoni*; bullæ also rather larger than in that species.

Dimensions of the type:—

Head and body 93 mm.; tail 128; hind foot (s. u.) 25; ear 13.

Skull—greatest length 29; basilar length 21; zygomatic breadth 16; nasal length 10·6; interorbital breadth 5·7; brain-case, breadth 14; diastema 7·3; palatal foramina 5·1; length of upper molar series 4·1; greatest diameter of bulla 10·8.

Hab. of type. Eleusher.

Type. Male, not old. Original number 149. Killed 24 July, 1901.

This Gerbille represents the Egyptian *G. andersoni* de Wint., and is distinguished from that animal by its larger and more bulbous brain-case.

Besides their other differences in colour and proportions, the three forms of Hairy-footed Gerbille obtained by Mr. Dodson are distinguishable by the breadth of their molars, *G. p. tarabuli* having these about 1·7 across the broadest part of m^1, *G. eatoni* 1·5 or 1·6, and *G. hirtipes* 1·4. An old specimen with worn teeth, collected by Mr. O. V. Aplin in Tunis in 1895, and also presented to the Museum by Mr. Whitaker, seems likewise to be referable to *G. eatoni*.

I have named this pretty Gerbille in honour of the Rev. A. E. Eaton, to whose collections from Algeria our ability to work out any North-African Muridæ is largely due. The old inexactly labelled material is of little use, and Mr. Eaton's specimens are the only ones in the Museum from Algeria collected in proper

style. It is to be hoped that they may be soon further supplemented.

8. DIPODILLUS DODSONI, sp. n.

6. 8. 9. W. Nefed. 14-15/4/1.
18. 21. 22. 23. 25. 29. Ain Hammam. 27-29/4/1.
34. 37. 39. Tamari-Ferdjan. 5/5/1.
46. 50. 55. Oum el Abid. 11-14/5/1.
68. Grodua. 23/5/1.
79. 83. 84. Shup. 8-10/6/1.
100. Ain Hammam. 24/6/1.
100. W. Agarib. 1/7/1.

Essential characters of *D. campestris*, but larger, more desert-coloured, and with a longer and more heavily tufted tail.

Size larger than in the true *D. campestris* of the coast-lands.

Fur longer and looser. General colour above sandy buff, varying from light ochraceous buff to a dull isabella. Usual orbital and postauricular white patches present. Under surface pure white, the line of demarcation less sharply defined than in the closer-haired *D. campestris*. Ears of medium size, naked; clear greyish. Hands and feet white; palms and soles naked; six sole-pads present. Tail very long, heavily tufted in its terminal half, the hairs of the tip attaining about 15 mm. in length; its base sandy above, white below, the tuft brown above, duller white below.

Skull quite like that of *D. campestris*, but rather larger in all dimensions.

Measurements of the type:—

Head and body 101 mm.; tail 143; hind foot 28 (range 26–29); ear 15.

Skull—greatest length 31; basilar length 22·2; zygomatic breadth 16·5; length of nasals 12; interorbital breadth 5·1; diastema 8; palatal foramina 5·5; upper molar series 4·1.

Typical locality. Ain Hammam.

Type. Adult male. Original number 29. Killed 29 April, 1901.

This fine tufted-tailed Gerbille is the representative of *D. campestris* south of the Atlas, and was not distinguished by Lataste from that species. But the true *D. campestris* of the coast-lands of Algeria is rather smaller, much browner in colour, and its tail has far less tuft than *D. dodsoni*. The type locality was Philippeville, on the coast of Constantine, and examples from the coast as far westward as Mogador practically agree with those from this district. On the other hand, on the south side of the mountains, desert Algerian examples, obtained by Mr. Eaton at Biskra, are referable to the Tripolitan *D. dodsoni*.

Of the four species of Loche and Levaillant said with doubt by Lataste to belong to the *campestris* group:—

No. 69, *Gerbillus deserti*, is clearly not this species, being far too short-tailed. It is perhaps a young *G. hirtipes* or *G. simoni*.

No. 70, *G. gerbii*, comes from Beni Sliman, about 40 miles south of Algiers. Therefore north of the mountains, and within the area of true *G. campestris*.

No. 72, *Psammomys minutus*, is possibly *D. dodsoni*, but the name is unavailable, being based on the totally different *Dipus minutus* Geoffr.

No. 80, *Mus chamæropsis*, is clearly a *Mus*, as its smooth incisors testify.

9. Dipodillus vivax, sp. n.

27. Ain Hammam. 29/4/1.
66 Sebha. 19/5 1.

Closely allied to the Egyptian *D. quadrimaculatus* Lat. and *amœnus* de Wint., which it no doubt replaces in Tripoli.

Size as in *D. amœnus*. General colour above bright uniform ochraceous buff, scarcely lined with brown. Belly and limbs pure white. Upper whiskers brown, lower white. Usual white face-marks well defined. Tail about as long as in *D. amœnus*, pencilled above terminally, the hairs about 10 mm. in length; pale fawn lined with brown above, the pencil-lines brown, below paler, or whitish fawn.

Skull very like that of *D. amœnus*, rather smaller than that of *D. quadrimaculatus*; differing from both by its decidedly larger bullæ, and the consequent narrowness of the basioccipital between them.

Dimensions of the type:—

Head and body 75 mm.; tail damaged (of the second specimen 106); hind foot 21; ear 12.

Skull—greatest length 26·7; basilar length 19·7; zygomatic breadth 14·5; nasal 9·7; interorbital breadth 4·4; breadth of brain-case 12·6; diastema 6·7; palatal foramina 4·2; greatest diameter of bullæ 10·1; length of upper molar series 3·2; width of m^1 1·2.

Typical locality. Sebha.

Type. Male. No. 66. Killed 19 May, 1901.

This Tripolitan representative of the *quadrimaculatus*-group is readily distinguishable from its Egyptian allies by its larger bullæ and brighter and more uniform ochraceous buffy colour. No members of the group have been recorded from Algeria.

10. Meriones shawi Rozet.

2. Tarhuna. 6/4/1.
4, 5. 7. 11. W. Nefed. 14 15/4/1.
146. 150. Elcusher. 24/7/1.
152–153. 156. 157. 158. W. Aggar. 25-26/7/1.
162. Bou Cheifa. 2/8/1.

In spite of the large number of localities at which one or other of the two species were taken, it is noticeable that at no single place did Mr. Dodson catch both *M. shawi* and *M. schousboei*. Perhaps they will prove to be mutually exclusive, as they are so

alike in size and general characters. Indeed it is almost impossible to distinguish them externally from each other, though *M. shawi* has on the average a rather duller or more drab tone than *M. schousboei*. Nor are the skulls less alike, except for the characteristic difference in the size of the bullæ.

11. Meriones schousboei Loche.

Gerbillus schousboei Loche, Expl. Sci. Alg., Mamm. p. 105 (1867).

20. 26. 33. Ain Hammam. 28/4–2/5/1.
40. Tamari-Ferdjan. 5/5/1.
53. 54. Oum el Abid. 13–14/5/1.
60. Zighen. 15/5/1.
72. Serir, Mursuk. 1/6/1.
88. Koshby. 16/6/1.
93. 94. 96. 97. Ferdjan. 19–21/6/1.
112. W. Agarib. 3/7/1.
115. 116. W. Wagis. 7/7/1.
121–135. 138–142. G. Limhersuk. 14–19/7/1.
143–144. Gebel Binsertia. 20/7/1.
163. Sidi Sweya. 5/8/1.

Although the group is too difficult to be worked out in detail, the name adopted seems the best to use for the Barbary representative of the *M. erythrurus*-group. Its reference to that group is accepted on the authority of Lataste.

12. Psammomys tripolitanus, sp. n.

155. W. Aggar. 25/7/1.
160. W. Cheggar. 28/7/1.
161. Bou Cheifa. 1/8/1.

Size fairly large, though smaller than in *P. algiricus*. Median facial and dorsal area dark buffy (something between "wood-brown" and "pinkish-buff"). Sides and belly yellow. Cheeks pale greyish. Upper surface of hands and feet yellowish white. Tail strong buffy, the crest and pencil black; terminal hairs of pencil attaining about 14 mm.

Skull smaller and more delicately built than in the other large species, though markedly larger than in *P. roudairei*. See dimensions below. Bullæ small and narrow; the part that appears on the top of the squamosal particularly small.

Dimensions of the type:—

Head and body 157 mm.; tail 135; hind foot 35; ear 14.

Skull—greatest length 41·5; basilar length 34·3; zygomatic breadth 24; nasals 15·3; interorbital breadth 6·5; least breadth between ridges on parietals 10·5; breadth between anterior lips of meatus 24; length of exposed upper area of bulla 5·4; diastema 12·1; greatest diameter of bulla 14·3, lesser diameter, from anterior lip of meatus, 11·5; length of upper molar series 6·8.

Typical locality. Bou Cheifa, on the coast.

Type. Old male. No. 161. Killed 1 August, 1901.

As hown elsewhere[1], the species of *Psammomys*, apart from *Ps. elegans*, which I do not know, and the much smaller *Ps. roudairei*, fall readily into four distinguishable forms respectively inhabiting Algeria, Tripoli, Lower Egypt, and Palestine. They are distinguished mainly by size and the relative development of their bullæ, their external appearance being all very much the same.

13. PSAMMOMYS ROUDAIREI Lat.

14. ♀. Bonjem. 20 April, 1901.
117. ♀. W. Wagis. 7 July, 1901.

I have always considered M. Lataste was unnecessarily hasty in withdrawing his name *Psammomys roudairei*, for there are clearly two species—a larger darker, and a smaller paler one—living together in Algeria and Tripoli; and, although undoubtedly immature, his two type specimens (of which the British Museum possesses one) evidently belong to the smaller form. The name itself would have stood in any case, for, as has already been seen, the large western *Psammomys* is different from *Ps. obesus*, and has not hitherto had a tenable name applied to it.

The second specimen above recorded is only doubtfully placed here, as it is immature, and members of this group are almost impossible of satisfactory determination unless fully adult.

14. MUS MUSCULUS ORIENTALIS Cr.

1. Tarhina. 5 April, 1901.

15. ACOMYS VIATOR, sp. n.

90. ♀. Wadi Sultan, near Sokna. 18/6/1.

Size fairly large. Spines of back about 11 mm. long, by barely half a millimetre broad. General colour above pale slaty grey anteriorly, changing to dull pale rufous posteriorly. Individually the dorsal spines are pale grey (near smoke-grey of Ridgway), with their extreme points dark brown, and with a narrow pale rufous subterminal band; under surface pure white throughout. Head and shoulders plain grey, the spines narrower and grey throughout, without darkened points. Ears rather small, pale greyish, a white spot below their outer base. Hands and feet white. Tail of medium length, greyish brown above, white below.

Skull smaller than in *A. dimidiatus*, the brain-case of medium size and its ridges not conspicuously heavy or broadened. Palatal foramina to the posterior third of m^1. Opening of posterior nares 2·3 mm. behind back of m^3. Bullæ smaller than in *A. dimidiatus*, their antero-external–postero-internal breadth 4·2 mm.

Dimensions of the type:—

Head and body 110 mm.; tail 107; hind foot 19·5; ear 19.

Skull—greatest length 29; basilar length 21·5; zygomatic breadth 14; nasals, length 11; interorbital breadth 4·6; breadth

[1] Ann. Mag. N. H. (7) ix. p. 363 (1902).

of brain-case 12·2; palate, length 13·5; diastema 7·4; palatal foramina 7; length of upper molar series 4·1.

Habitat and *Type* as given above.

This species is smaller and greyer than *A. dimidiatus*, paler and more rufous than *A. cahirinus*. It represents the most westerly recorded locality of the genus *Acomys* in Northern Africa.

Mr. Dodson tells me that these Spiny Mice, comparatively dark among their pallid neighbours, resemble the small blackish stones which lie about among the Soda Mountains, but were not elsewhere met with in the region traversed.

16. JACULUS GERBOA Oliv.

164. ♂. Sidi Faradje. 6/8/1.

17. JACULUS JACULUS L.

62. Attich Loumonileh.

118, 120. Ounsinerma. 10-12/7/1.

As usual, Jerboas are far less numerous in the collection than Gerbilles, and at present material does not exist for an exact comparison of Algerian, Tripolitan, and Egyptian specimens.

Mr. de Winton has pointed out to me that the names *Jaculus* for the genus and Jaculidæ for the family must stand instead of *Dipus* and Dipodidæ.

18. CTENODACTYLUS VALI, sp. n.

13. Wadi Bey. 19/4/1.

104. W. Titti, east of Sokna. 27/6/1.

External characters very much as in *C. gundi*. General colour approximately pinkish buff above, nearly white below, the hairs dull slaty basally. Face rather paler than body. Ears light cream-colour, their edges scarcely blackened. Upper surface of hands and feet and whole of tail pale cream-colour. Tail thin, shorter than the foot, its terminal hairs about 20 mm. in length.

Skull in general shape as in *C. gundi*, but with enormous bullæ, as in *Massoutiera mzabi*. Nasals long and narrow, little broadened in front. Anteorbital projections comparatively delicate. Interparietal of medium size, less broad than in *gundi*. Bullæ enormous, but the opening of the meatus is visible outside them in an upper view; anteriorly above they reach forward nearly to touch the well-developed postero-external projection of the zygomatic process of the squamosal; medially their anterior half extends on the upper surface to within 7 mm. of the middle line, and their posterior half to within 4·5 mm.; posteriorly they project far behind the occipital plane, which is only 7 mm. wide between them. Paroccipital processes comparatively small. Palatal foramina as in *C. gundi*. Posterior nares narrow, angular. Molars small and delicate, shorter antero-posteriorly than in *C. gundi*, the last molar less distinctly L-shaped than in that species, and to that extent marking a slight step towards the condition in *Massoutiera*.

Dimensions of the type:—

Head and body 187 mm.; tail 20; hind foot 34; ear 14.

Skull—greatest median length 47·5; basilar length 35·5; gnathion to most posterior point of bulla 49; zygomatic breadth 31; nasals 18 × 5·5; interorbital breadth 12·2; interparietal 8·8 × 1·1; diastema 11; palatal foramina 8 × 4; upper molar series 8·2; greatest oblique diameter of bullæ below 18·1; greatest oblique diameter, as seen from above, nearly at right angles to last 17·2; vertical height of bullæ 17; height of lower jaw, from condyle, 10·5.

Typical locality. Wadi Bey, just northwest of Bonjem.

Type. Old female. No. 13. Killed 19 April, 1901.

This animal is the most distinct from its allies of all the species found by Mr. Dodson, and bearing in mind the fewness of the members of the *Ctenodactylinæ*, the discovery of so well-marked a new form is a matter on which Mr. Whitaker may well be congratulated.

19. Lepus whitakeri, sp. n. (Plate I.)

3. Wadi Sofedjin. 12/4/1.
61. Timinint. 17/5/1.
111. W. Agarib. 2 7 1.

A very handsome pinkish-buff Hare, quite distinct from all its allies.

Size medium. General colour a rich pinkish buff, richer and more pinkish than in *L. æthiopicus*, the species to which *L. whitakeri* has the greatest external resemblance. On the back the general colour is more or less lined with black, but on the forehead it is clear and rich, not greyer as is often the case. Nape rather deeper in colour, approaching "vinaceous buff" in the darkest specimen. Eyes with indistinct whitish rings, but scarcely a trace of the pre- and postorbital white patches present in *L. æthiopicus*. Ears long, buffy, the marginal hairs whitish buffy; back of tips rather browner, but no distinct terminal patch. Sides and chest rich pinkish buffy; chin and belly white, not sharply defined laterally. Limbs buffy, the inner side of the arms and thighs whitish; long hairs of palms and soles yellow or reddish. Tail black above, pure white on the sides and below.

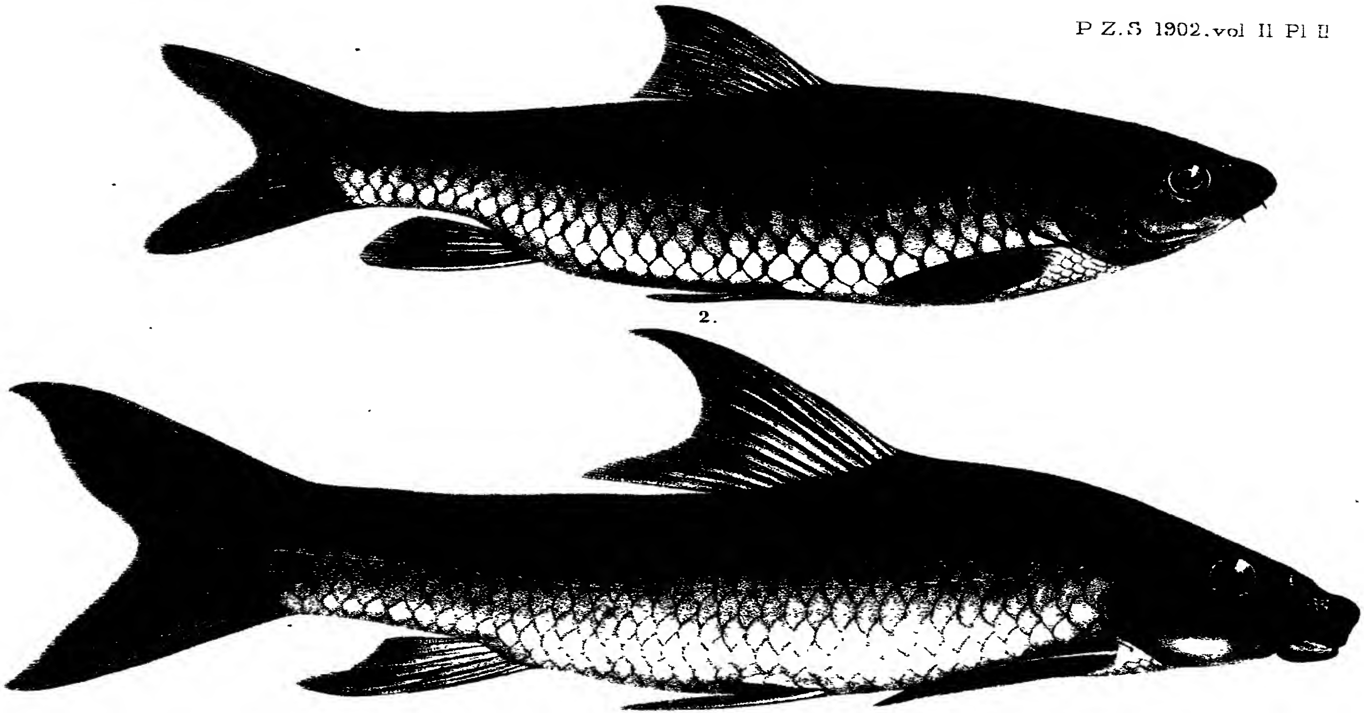
"Irides yellow-ochre."

Skull not unlike that of *L. æthiopicus*, but rather narrower, and with less broadly expanded supraorbital wings. Enamel of incisors forming a simple angular notch, not penetrating deeply into the tooth, and not filled up with cement. In this last respect *L. whitakeri* agrees rather with the very differently coloured Algerian species than with *L. æthiopicus* and its allies.

Dimensions of the type:—

Head and body 420 mm.; tail 70; hind foot 100; ear (measured dry) from crown 140, from notch 121.

Skull—greatest length 83; basilar length 67; zygomatic breadth 38·5; nasals, oblique length 34, greatest breadth 17·5, least



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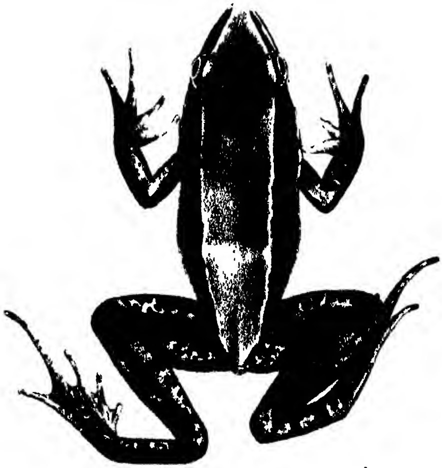
1 LABEO DARLINGI 2. BARBUS RHODESIANUS



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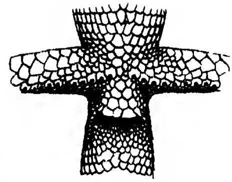

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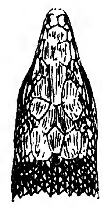

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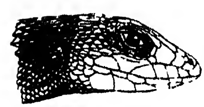

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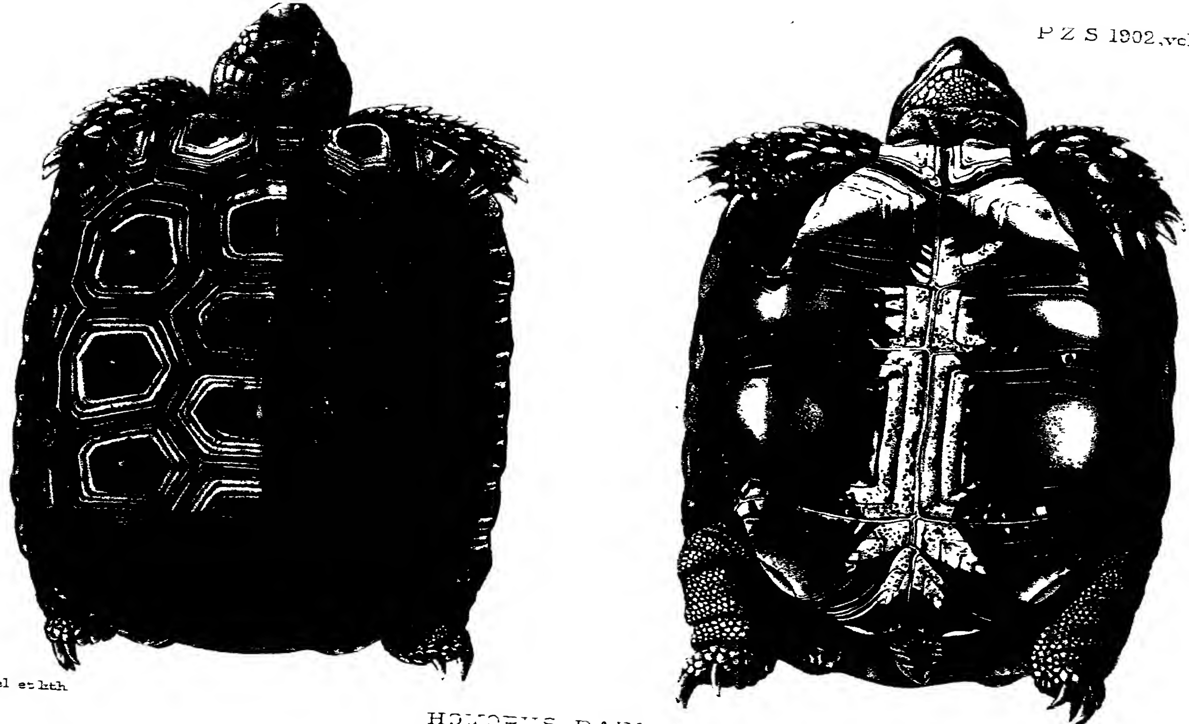
1. RANA DARLINGI. 2 ICHNOTROPIS LONGIPES.



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HOMOPUS DARLINGI

Mintern Bros imp

breadth 11·5; interorbital breadth inside wings 17, between tips of wings 27; inter-temporal breadth 10·7; breadth of brain-case 27; posterior breadth between lips of meatus 35; diastema 24; palate length 29·5; palatal foramina 21×10; length of cheek-tooth series (alveoli) 14·5; antero-posterior diameter of bulla 13.

Typical locality. Wadi Agarib, just N.W. of Sokna.

Type. Male. No. 111. Killed 2 July, 1901.

This fine Hare, which is named in honour of Mr. Whitaker, to whose enterprise and generosity the whole of the Tripoli collection is due, is readily distinguishable from all its allies by its remarkable colour and the character of its incisors.

This species seems widely distributed in Tripoli, from Wadi Sofedjin in the north, to Timinint, near Sebha, in the south.

20. Gazella dorcas, L.

12. ♀. Erdeul. 18/4/1.
44. ♀. Linzerat. 7/5/1.
45. ♀. Oum el Abid. 11/5/1.
85. 86. 87. ♀ ♂ ♂. El Koshby. 15/6 1.
119. 136. 137. 3 ♀. Limhursuk. 15 16/7 1.

21. Ammotragus lervia Pall.

108. ♂. W. Agarib. 29 6/1.

EXPLANATION OF PLATE I.

Lepus whitakeri, p. 12.

2. A List of the Fishes, Batrachians, and Reptiles collected by Mr. J. ffolliott Darling in Mashonaland, with Descriptions of new Species. By G. A. Boulenger, F.R.S.

[Received April 14th, 1902.]

(Plates II.-IV.[1])

The fauna of Rhodesia is still so imperfectly worked out that all zoologists will feel grateful to Mr. Darling for the trouble he has taken in forming collections in the part of the country in which he has been residing for the past few years, viz. the district about Salisbury. The series of Fishes, Batrachians, and Reptiles, the names of which follow, was collected at Mazoë and between Umtali and Marandellas, and presented by him to the British Museum. Two Fishes, a Frog, a Tortoise, and a Lizard are new to science.

FISHES.

1. Labeo darlingi, sp. n. (Plate II. fig. 1.)

Body compressed, its depth nearly equal to the length of the head and contained 4 times in the total length. Head $1\frac{1}{2}$ as long as

[1] For explanation of the Plates, see p. 18.

broad; snout rounded, strongly projecting beyond the mouth, with scars of small horny warts; eye perfectly lateral, in the middle of the head, its diameter $4\frac{1}{2}$ times in the length of the head, $2\frac{1}{4}$ in the width of the interorbital region, which is flat; width of mouth, with lips, $\frac{2}{3}$ that of the head; rostral flap and anterior border of lip not denticulated; lower lip with a series of papillæ forming a denticulation; inner surface of lip with numerous transverse plicæ, formed of closely-set obtuse papillæ; a minute barbel, hidden in the folds at the side of the mouth. Dorsal II 10, with strongly notched upper border; the longest ray exceeds the length of the head; fin equally distant from the nostril and the root of the caudal. Anal II 5, longest ray nearly as long as the head and reaching the root of the caudal. Pectoral subfalciform, as long as the head, not reaching the base of the ventral. Ventral nearly reaching the vent, its first ray falling under the seventh of the dorsal. Caudal deeply forked. Caudal peduncle scarcely longer than deep. Scales $36\frac{6\frac{1}{2}}{6\frac{1}{2}}$; 4 series between the lateral line and the root of the ventral, 16 round the caudal peduncle. Olive-brown above, whitish beneath; fins dark.

Total length 160 millim.

A single specimen.

Very closely allied to *L. cylindricus* Peters, from the Zambesi, but body strongly compressed, eye occupying the middle of the head, and one scale more in the transverse series above the lateral line.

2. Barbus trimaculatus Peters.

3. Barbus rhodesianus, sp. n. (Plate II. fig. 2.)

Depth of body $3\frac{1}{2}$ to $3\frac{2}{3}$ times in the total length, length of head 4 to $4\frac{2}{3}$ times. Snout rounded, feebly projecting beyond the mouth, $\frac{1}{3}$ the length of the head; diameter of the eye $3\frac{2}{3}$ to $4\frac{1}{2}$ times in the length of the head, $1\frac{1}{2}$ to $1\frac{2}{3}$ in the interocular width; mouth rather small, its width half that of the head, with thin lips, with two pairs of subequal barbels measuring about half the diameter of the eye. Dorsal III 8–9, third ray not at all enlarged, smooth; the fin, which is equally distant from the eye and the root of the caudal, has the free edge notched and its longest ray measures $\frac{3}{4}$ to $\frac{4}{5}$ the length of the head. Anal II 5; the longest ray measures $\frac{3}{4}$ to $\frac{5}{6}$ the length of the head and nearly reaches the root of the caudal when folded. Pectoral a little shorter than the head, not reaching the ventral, the first ray of which falls below the anterior third of the dorsal. Caudal forked. Caudal peduncle about $1\frac{1}{2}$ as long as deep. Scales $30–32\frac{5\frac{1}{2}}{5\frac{1}{2}}$, $2\frac{1}{2}$ or 3 between the lateral line and the root of the ventral, 12 round the caudal peduncle. Dark olive-brown above, silvery below; fins dark.

Four specimens, measuring from 117 to 280 millim.

Allied to *B. marequensis* Smith, *B. altianalis* Blgr., and *B. bowkeri* Blgr. Differs from all three in the shorter barbels and

fewer scales in the lateral line; also from the first two by the weak third simple dorsal ray, and from the third in the smaller mouth with thinner lips.

4. Clarias gariepinus Smith.

BATRACHIANS.

1. Xenopus lævis Daud.

2. Bufo regularis Reuss.

3. Breviceps mossambicus Peters.

4. Rana adspersa Bibr.

5. Rana angolensis Bocage.

6. Rana darlingi, sp. n. (Plate III. fig. 1.)

Vomerine teeth in two slightly oblique, oval groups close together, just behind the level of the choanæ. Head moderate, depressed; snout as long as the diameter of the orbit, obtusely acuminate, projecting; nostril a little nearer the end of the snout than the eye; loreal region slightly concave; interorbital space a little narrower than the upper eyelid; tympanum very distinct, nearly as large as the eye. Fingers and toes moderate, with blunt tips; first finger extending a little beyond second; toes two-thirds webbed; subarticular tubercles small; a small oval inner metatarsal tubercle and a very indistinct, round outer one. The tibio-tarsal articulation reaches between the eye and the tip of the snout. Skin smooth; no distinct dorso-lateral fold. Pale grey above, black on the sides, the limit between the two shades sharply defined; a white labial streak from the tip of the snout to the arm; limbs freckled and spotted with dark brown; throat and breast grey-brown, belly marbled with grey-brown.

From snout to vent 53 millim.

Two female specimens.

7. Phrynobatrachus natalensis Smith.

8. Rappia marmorata Rapp.

REPTILES.

1. Sternothærus sinuatus Smith.

2. Homopus darlingi, sp. n. (Plate IV.)

Shell depressed, more than twice as long as deep, of subequal depth throughout, posterior margin feebly serrated; dorsal shields not swollen, with deep concentric grooves; a moderate-sized nuchal; vertebral shields broader than long, as broad as or a little broader than the costals; anterior plastral lobe truncate and $\frac{2}{3}$ the width of the bridge, posterior slightly notched and about $\frac{1}{2}$ that width; suture between the abdominal shields

longest, between femorals shortest; gular shields smaller than anals; axillary and inguinal shields rather large. Beak scarcely hooked; a large frontal and a pair of præfrontal shields. Fore limbs with moderately large imbricate scales of very unequal size, the largest raised and nail-like; no enlarged tubercles on the back of the thighs; fore limb with five claws, hind limb with four. Carapace black, each shield with a yellowish-brown areola; plastron black and yellow, with a median yellowish marking with dentate borders and speckled with olive-grey; head and limbs dark olive, the horny sheath of the jaws, the claws, and the larger scales on the fore limbs yellowish.

Length of carapace 93 millim.

A single female specimen.

This very distinct species is most nearly related to *H. signatus* Walb., from which it differs, apart from the coloration, in the large frontal shield and the absence of a large conical tubercle on the back of the thigh.

3. Lygodactylus capensis Smith.

4. Pachydactylus affinis Blgr.

Several specimens, from between Umtali and Marandellas, enable me to supplement the description of this Gecko given in 1896[1] from a single specimen obtained in the Rustenberg district of the Transvaal.

Naso-rostrals in contact; 8 to 10 upper labials; 7 lower labials. Tail feebly depressed, tapering to a fine point, covered with equal smooth scales, which are hexagonal and juxtaposed on the upper surface, roundish and subimbricate on the lower surface. Pale brown above, with round blackish spots intermixed with smaller round white spots; a blackish streak on each side of the head, passing through the eye; lower parts white.

Total length	90 millim.	Fore limb	13 millim.
Head	12 „	Hind limb	17 „
Width of head ...	9 „	Tail	45 „
Body	33 „		

5. Agama aculeata Merr.

6. Agama kirki Blgr.

7. Agama atricollis Smith.

8. Platysaurus guttatus Smith.

A male specimen, measuring 110 millim. from snout to vent, tail 170. Differs from the type in having the fronto-nasal forming a short suture with the rostral, separating the nasals, and in the absence of a shield between the interparietal and the occipital, which are in contact with each other. 18 femoral pores

[1] Ann. & Mag. N. H. (6) xvii. 1896, p. 21.

on each side. Back dark grey, with lighter dots; limbs and belly black; tail orange.

9. Ichnotropis longipes, sp. n. (Plate III. fig. 2.)

Closely allied to *I. capensis* Smith, with which it entirely agrees in the scaling, but body shorter and limbs longer, the hind limb, if pressed against the body, reaching between the ear and the eye. Foot much longer than the head. 36 to 40 scales round the middle of the body. 9 or 10 femoral pores on each side. Pale grey-brown above, tinged with orange on the sides of the back, which is unspotted; a black streak along each side, from the tip of the snout, through the eye, to the anterior fourth of the tail; a second black streak along the upper lip, extending to the shoulder and separated from the upper one by a white streak; some large black spots on the hind limbs; lower parts white.

Total length	160 millim.		From end of snout to vent...........	49 millim.	
Head	13	,,	Fore limb	19	,,
Width of head ...	8	,,	Hind limb	33	,,
From end of snout to fore limb......	21	,,	Tail	111	,,

This new Lizard is represented by three male specimens.

10. Gerrhosaurus flavigularis Wiegm.

11. Mabuia quinquetæniata Licht.

12. Mabuia varia Peters.

13. Mabuia striata Peters.

14. Lygosoma sundevalli Smith.

15. Acontias meleagris L.

16. Chamæleon dilepis Leach.

17. Typhlops schlegeli Bianc.

18. Typhlops mucruso Peters.

19. Glauconia nigricans Schleg.

20. Boodon lineatus D. & B.

21. Pseudaspis cana L.

22. Chlorophis natalensis Smith.

23. Philothamnus semivariegatus Smith.

24. Prosymna ambigua Bocage.

25. Dasypeltis scabra L.

26. Trimerorhinus tritæniatus Gthr.

27. Psammophis sibilans L.

Uniform olive-brown above, down to the ends of the ventral shields, which are unspotted; lips yellowish, spotted with olive-brown.

28. Dispholidus typus Smith.

29. Aparallactus capensis Smith.

30. Aparallactus guentheri Blgr.

31. Naia haie L.

A perfectly typical young specimen, with 21 scales across the neck, 19 across the body, 190 ventrals, and 60 caudals. Neck black, body brown above with indistinct darker spots, yellowish beneath. A large specimen from Salisbury, presented by Col. Rhodes some years ago, answers to Peters's var. *annulifera*.

32. Naia nigricollis Reinh.

33. Causus rhombeatus L.

34. Causus defilippii Jan.

35. Bitis arietans L.

EXPLANATION OF THE PLATES.

Plate II.

Fig. 1. *Labeo darlingi*, p. 13, natural size.
2. *Barbus rhodesianus*, p. 14, reduced ½.

Plate III.

Fig. 1. *Rana darlingi*, p. 15, natural size.
1 *a*. „ „ Side-view of head, natural size.
2. *Ichnotropis longipes*, p. 17, natural size.
2 *a*. „ „ Upper view of head, × 1¾.
2 *b*. „ „ Side-view of head, × 1¾.
2 *c*. „ „ Anal region, × 1¾.

Plate IV.

Homopus darlingi, p. 15, natural size, upper and lower views.

3. On the Ornithological Researches of M. Jean Kalinowski in Central Peru. By Graf Hans von Berlepsch and Jean Stolzmann.

Part II. (continued from P. Z. S. 1896, p. 388.)

[Received March 26, 1902.]

Nous continuons ici notre rapport sur les résultats des investigations ornithologiques de M. Jean Kalinowski au Pérou (1890–93), dont la première partie a été lue devant la Société en mars 1896.

Fam. Trochilidæ.

295. Doryfera ludoviciæ (Bourc. et Muls.).

? *D. rectirostris* Tacz. Orn. du Pérou, i. p. 284.

La Garita del Sol: un mâle adulte, 5 juillet 1891.

Al. 63, caud. 35, culm. 32 mm.

L'oiseau envoyé est tout-à-fait identique aux échantillons de Bogotá, il a seulement le bec un peu plus court que la majorité des oiseaux colombiens.

296. Phaëthornis gayi emiliæ (Bourc. et Muls.).

Ph. emiliæ Tacz. Orn. du Pérou, i. p. 268.

La Gloria: deux mâles et une femelle d'août 1890 et de janvier et février 1891.

Les individus du Pérou central s'accordent bien en général avec les oiseaux typiques de Bogotá, si ce n'est peut-être qu'ils ont les ailes un peu plus courtes et le dos plus obscur (moins luisant), la mandibule inférieure plus distinctement terminée de noirâtre.

297. Phaëthornis rufigaster longipennis, subsp. nov.

Ph. Ph. rufigaster (*Vieill.*) *dicto ex Brasilia simillimus, differt alis multo longioribus.*

♀ ♀. Al. $43\frac{3}{4}$–$41\frac{1}{2}$, rectr. med. $34\frac{3}{4}$–$33\frac{3}{4}$, submed. 27, extern. $15\frac{1}{2}$, culm. $21\frac{3}{4}$-$20\frac{3}{4}$, caud. graduata 19–$18\frac{1}{2}$ mm.

Hab. in Peruvia centrali or.: Chanchamayo.

Typus in Mus. Branicki.

La Merced: une femelle du 21 août 1890. Borgoña: une femelle du 23 mai 1891. "Iris noir, bec noir à moitié basale de la mandibule inférieure jaune de cire, pattes d'un jaune de cire."

Quant à leur coloration, les oiseaux de Chanchamayo s'accordent parfaitement avec les oiseaux du Brésil (*Ph. rufigaster*). Ils s'en distinguent néanmoins par les ailes beaucoup plus longues. La longueur de l'aile est de $41\frac{1}{2}$ à $42\frac{3}{4}$ mm., tandis qu'elle est de 34 à 37 mm. chez une vingtaine d'individus du *Ph. rufigaster* du Brésil mesurés par Berlepsch. Il n'y a pas d'autres différences et les relations de cette forme du Pérou central sont évidemment avec le *Ph. rufigaster* et non avec le *Ph. nigricinctus* Lawr. de l'Amazone supérieur, qui a la mandibule inférieure presque entièrement blanche, tandis que nos oiseaux présentent la moitié terminale de la mandibule noirâtre comme chez le *Ph. rufigaster*. Les pointes des rectrices médianes sont rousses comme chez cette dernière espèce et non blanches comme chez le *Ph. stuarti* Hartert de la Bolivie.

298. Eutoxeres condaminei gracilis, subsp. nov.

E. condaminei Tacz. Orn. du Pérou, i. p. 259 (Pérou centr.).

E. E. condaminei *dicto simillimus, differt rostro multo breviore et graciliore, alis quoque brevioribus, necnon striis fulvescentibus*

gulæ pectorisque multo latioribus, dorso magis æneo-viridi et tectricibus caudæ inferioribus minus cærulescente lavatis.

♂. Al. $74\frac{1}{2}$, caud. $59\frac{1}{2}$, culm. $29\frac{1}{4}$ mm.
♀. „ 65, „ $47\frac{1}{2}$, „ $29\frac{1}{2}$ „

Hab. in Peruvia centrali: Vitoc.

Typus in Mus. Branicki.

Vitoc, Garita del Sol: un mâle adulte du 24 mars 1893 et une femelle du 17 août 1891. "Iris noir; bec noir, corné, à mandibule inférieure d'un jaune olivâtre à la base, pattes d'un brun jaunâtre."

Les deux oiseaux recueillis par M. Kalinowski, dont le mâle paraît tout-à-fait adulte, tandis que l'oiseau marqué femelle est peut-être jeune, diffèrent des échantillons de l'*E. condaminei* de l'Ecuador par le bec beaucoup plus court, plus faible et plus courbé, les ailes également plus courtes. Quant à la coloration, les oiseaux péruviens diffèrent par les stries fauves de la gorge et de la poitrine plus larges et plus claires (blanchâtres sur la poitrine), par le dos d'un vert plus jaunâtre ou plus doré, les tectrices souscaudales moins lavés de bleuâtre, les rectrices médianes d'un vert plus vif et demi-luisant au lieu d'un vert noirâtre, enfin par les rectrices externes d'un cannellé plus pâle.

299. Patagona gigas (Vieill.).

Acobamba: une femelle du 20 septembre 1890; une autre de Tarma du 7 août 1893.

300. Leucippus chionogaster (Tsch.).

La Merced: trois mâles de juillet et septembre 1890. Garita del Sol: trois femelles de juin, juillet et août 1891.

301. Agyrtria bartletti (Gould).

La Merced: cinq mâles de juillet et août 1890, un mâle et deux femelles de janvier et février 1891. "Bec et pattes noirs, mandibule inférieure d'un carné-rosâtre dans sa moitié basale."

Il n'y a pas de différence entre ces oiseaux et les individus de l'Ucayali recueillis par M. G. Garlepp (Mus. Berlepsch).

302. Chrysuronia josephinæ (Bourc. et Muls.).

La Merced, Quimiri: un mâle adulte.

Al. $55\frac{1}{4}$, caud. 35, culm. $17\frac{1}{2}$ mm.

Ce mâle tout-à-fait adulte diffère des individus de Huambo et de Rioja (Pérou du nord) par le bec plus court, le violet de la tête plus brillant, plus rougeâtre et plus prolongé jusqu'à la nuque, enfin par le manque d'une tache bleue bien marquée sur le menton. Il n'y a que deux petites plumes bleues-violettes et une petite raie bleue-violette en forme de moustache sur chaque côté de la gorge.

303. Chlorostilbon prasinus daphne Gould.

Chl. prasinus Tacz. Orn. du Pérou, i. p. 414.

La Merced : trois mâles de juillet et août 1890. Borgoña : un mâle du 8 juin 1891. Garita del Sol : un mâle du 3 septembre 1891.

Le type du *Chl. daphne* Gld. venait des Pampas del Sacramento, région pas trop eloignée de Chanchamayo. Cette forme diffère du *Chl. prasinus* typique du Brésil par le bec, les ailes et la queue plus longs, la queue légèrement échancrée au lieu d'être parfaitement arrondie, enfin par les côtés de la gorge moins dorés.

304. Thalurania jelskii Tacz.

La Gloria et La Merced : un mâle et trois femelles d'août et septembre 1890. La Gloria, janvier 1891, et Borgoña, mai 1891 : quatre mâles.

♂ ad.	Al. $61\frac{1}{2}$,	caud. $45\frac{1}{2}$,	culm. $19\frac{3}{4}$,	caud. furca $14\frac{3}{4}$ mm.
♀ jr.	„ $58\frac{1}{4}$,	„ $38\frac{1}{2}$,	„ $19\frac{3}{4}$,	„ „ $11\frac{1}{2}$ „
♀ ♀ et ♂ juv.	„ $55-54\frac{1}{2}$,	„ $33\frac{1}{2}$ 32,	„ $21-19\frac{3}{4}$,	„ „ $3\frac{1}{2}-1\frac{3}{4}$ „

L'oiseau typique mesuré par feu Taczanowski, qui se trouve au Musée de l'Université de Varsovie, doit être un mâle encore incomplètement développé, car les mâles adultes recueillis par M. Kalinowski ont les dimensions beaucoup plus grandes et sous ce rapport surpassent même les adultes de la *Th. nigrofusciata* (Gld.).

La *Th. jelskii* qui habite aussi la Bolivie, d'où Berlepsch a reçu un grand nombre d'exemplaires recueillis par M. G. Garlepp, se distingue principalement des espèces voisines *Th. nigrofusciata* et *Th. tschudii* par la forme de la plaque verte métallique de la gorge coupée en dessous presque en ligne droite, tandis que chez les deux autres espèces que nous venons de nommer ce vert se prolonge en se rétrécissant jusqu'au milieu de la poitrine, où il prend une nuance bleu-verdâtre chez la *Th. tschudii*.

305. Colibris iolatus (Gld.).

Petasophora anais Tacz. Orn. du Pérou, i. p. 367.

La Merced : quatre jeunes mâles de juillet et août 1890. La Garita : un mâle adulte et deux femelles des 30 juin, 4 et 23 juillet 1891. Tarma : un mâle adulte et deux femelles du 15 décembre 1890. Tapo : deux mâles du 27 décembre 1892.

Ces échantillons ne diffèrent des oiseaux typiques de la Bolivie que par le bec généralement un peu plus court et peut-être par les souscaudales moins variées de blanchâtre. Les individus de Bogotá et de l'Ecuador ont le bec *et les ailes* généralement plus courts que ceux de la Bolivie. Les oiseaux des environs de Cuzco (coll. O. Garlepp) s'accordent tout-à-fait avec les boliviens. Il serait difficile de constituer une sous-espèce, car les oiseaux de Pérou central quant à la longueur des ailes s'accordent avec les boliviens, et ne different que par leur bec généralement plus court.

306. Colibris cyanotus (Bourc. et Muls.).

Petasophora cyanotis Tacz. Orn. du Pérou, i. p. 369.

Maraynioc, Culumachay: un mâle en plumage très-usé du 24 juillet et un autre du 24 août 1892.

307. LAMPORNIS NIGRICOLLIS (Vieill.).

Lampornis violicauda Tacz. Orn. du Pérou, i. p. 281.

La Merced: une mâle adulte du 23 juillet 1890.

S'accorde avec les individus de Paraguay et du Brésil du Musée Berlepsch.

308. OREOTROCHILUS MELANOGASTER Gld.

Ingapirca: un jeune mâle de mai 1890. Tarma, Hacienda da Queta: femelles du 1 septembre et de décembre 1893.

309. PHÆOLÆMA CERVINIGULARIS Salv.?

"*Phæolæma æquatorialis*?" Tacz. P. Z. S. 1882, p. 35.

Phæolæma æquatorialis Tacz. Orn. du Pérou, i. p. 292.

Chanchamayo; La Garita: deux femelles du 14 juillet 1890 et du 29 juin 1891.

Al. 71, 69; caud. 44¾, 41; culm. 24½, 22¾; caudæ furca 7½ mm.

Ces femelles s'accordent avec une femelle de Rayurmana, Pérou du nord (coll. Stolzmann), en possédant une gemme améthyste sur la gorge, qui manque aux femelles de la *Ph. rubinoides* et de la *Ph. æquatorialis*.

Nous ne doutons pas que la femelle de Rayurmana appartienne à la *Ph. cervinigularis*, car elle présente une ligne de plumes écailleuses luisantes prolongée du front jusqu'au milieu du vertex. Les femelles de Chanchamayo et de Garita ne présentent qu'une petite marque de plumes luisantes au front, non prolongée jusqu'au piléum. Il faudra donc attendre les mâles adultes du Pérou central pour voir s'ils diffèrent peut-être dans ce même caractère des mâles de la *Ph. cervinigularis* Salv. de l'Ecuador.

310. LAMPRASTER BRANICKII Tacz.

La Gloria: deux mâles adultes du 6 août 1890 et du 18 janvier 1891.

Al. 67½, caud. 41, culm. 20¾, caud. furca 7 mm.

Les oiseaux recueillis par M. Kalinowski, dont l'un orne le Muséum Branicki, l'autre le Muséum Berlepsch, s'accordent avec l'oiseau typique de Monterico du Muséum de Varsovie. Ces trois échantillons sont jusqu'à présent les seuls représentants de cette belle espèce dans les collections scientifiques.

Malheureusement nous n'avons pas d'individus de l'*Aphantochroa gularis* Gld. à comparer; mais, pour autant que nous pouvons juger d'après les descriptions et la figure dans l'ouvrage de M. Gould, ces deux espèces paraissent alliées ou peut-être congénériques. Comme il paraît, le *L. branickii* diffère de l'*A. gularis* par le bec plus court et droit au lieu d'être courbé, par le noir uniforme des rectrices externes, par la présence des plumes écailleuses au front, par le roux des rémiges secondaires, enfin par

la gemme de la gorge d'un rouge de feu au lieu d'un rosé-lilas. Toutes les deux ont les tectrices souscaudales d'un blanc pur.

311. Heliodoxa leadbeateri (Bourc.).

Heliodoxa otero Tacz. Orn. du Pérou, i. p. 287.

Garita del Sol : un mâle adulte et deux jeunes mâles de juin et d'août 1891, une femelle du 22 juillet 1891, et un mâle adulte du 1 avril 1893. "Iris et bec noirs, pattes brunes."

312. Helianthea dichroura Tacz.

Maraynioc : trois mâles et deux femelles d'octobre, novembre et décembre 1891, et deux mâles ad. de Pariayacu de février et juin 1893. "Bec noir, pattes d'un carné-brunâtre."

♂.	Al. 86,	caud. $55\frac{1}{2}$,	culm. $33\frac{1}{2}$,	caud. furca	$6\frac{1}{2}$ mm.
♀.	„ 79,	„ 50,	„ 35,	„	$6\frac{1}{2}$ „

Espèce bien distincte de la *H. osculans* Gld., du Pérou du sud. Des échantillons recueillis par M. O. T. Baron dans le Pérou du nord oriental s'accordent avec les individus typiques de Maraynioc.

313. Bourcieria insectivora (Tsch.).

Maraynioc : mâles adultes du 3 novembre 1892 ; Tuyas yacu : un oiseau sans indication de sexe (femelle ?) du 17 août 1892, mâles et femelles de mars et avril 1893.

♂.	Al. 79,	caud. 49,	culm. 31 mm.
♀.	„ 74,	„ 45,	„ $33\frac{1}{2}$ „

Un mâle adulte de Huambo (Pérou nord-est) diffère par la gemme frontale plus grande et plus bleuâtre, par la plaque métallique du piléum plus bleuâtre, par le vert de la gorge plus bleuâtre, par le dos moins noirâtre dans sa partie supérieure, d'un vert plus bleuâtre dans la partie inférieure, enfin par la partie terminale verdâtre des rectrices externes plus courte et plus pâle. L'oiseau typique de Tschudi venait du chemin de Huari à Chagacancha (14,600 pieds).

314. Lampropygia columbiana obscura, subsp. nov.

Bourcieria cœligena Tacz. (nec Less.) Orn. du Pérou, i. p. 390.

L. L. columbiana *Elliot dictæ simillima, sed corpore supra subtusque obscuriore, gulæ plumis sordidius albis et maculis fuscis majoribus instructis distinguenda.*

♂.	Al. 79,	caud. $53\frac{1}{2}$,	culm. $31\frac{1}{2}$,	caud.	furca	13 mm.
♀.	„ $70\frac{1}{2}$,	„ 46,	„ $30\frac{1}{4}$,	„	„	8 „

Hab. in Peruvia centrali : Vitoc (coll. T. Kalinowski). Typus in Mus. Branicki, no. 2860 *a*.

Une paire de Garita del Sol, juillet 1891.

Les oiseaux du Pérou central diffèrent des oiseaux typiques de Bogotá par le plumage plus foncé en dessus et en dessous, la tête et le dos plus noirâtres, moins bronzés, l'abdomen plus noirâtre,

moins roussâtre, enfin par le fond de la gorge d'un blanc plus terne et plus grisâtre, à taches foncées plus larges. Ils ne ressemblent pas à la *L. cæligena* Less. du Vénézuela que nous croyons d'espèce bien distincte.

315. Lafresnayea saul rectirostris, subsp. nov.

L. gayi (part.) Tacz. Orn. du Pérou, i. p. 283.

L. L. saul (*Bourc.*) *dictæ ex Ecuador et Venezuela affinis, differt rostro breviore et rectiore, alis caudaque vero longioribus, necnon colore gulæ pectorisque maris pallidiore, magis aureoviridi.*

♂. Al. 67, caud. $42\frac{1}{2}$, culm. $22\frac{1}{2}$ mm.

Hab. in Peruvia centrali: Maraynioc (coll. Kalinowski). Typus in Mus. Branicki.

Maraynioc: mâle adulte du 16 décembre 1891; et Pariayacu: jeune mâle du 4 juillet 1892.

L'oiseau envoyé diffère de tous le mâles du Vénézuela, de l'Ecuador et d'un mâle de Cutervo, Pérou du nord (coll. Stolzmann), avec lesquels nous l'avons comparé, par le bec un peu plus court et presque rectiligne au lieu d'être sensiblement courbé, par les ailes et la queue au contraire plus longues. Le vert de la gorge, de la poitrine et des côtés du corps est plus clair et plus doré et le noir du milieu de l'abdomen est moins développé; la queue est un peu plus étagée.

316. Docimastes ensifer (Boiss.).

Docimastes ensiferus Tacz. Orn. du Pérou, i. p. 375.

Maraynioc: deux mâles adultes de novembre et décembre 1891. Pariayacu: deux femelles de juillet 1892 et de juin 1893.

Al. $79\frac{1}{2}$, caud. $62\frac{1}{2}$, culm. $83\frac{1}{2}$, caud. furca $25\frac{3}{4}$ mm.

Ces oiseaux diffèrent des oiseaux typiques de Bogotá que par le bec un peu plus long, par le vert de la poitrine généralement d'une nuance plus bleuâtre, enfin par le milieu du ventre d'une couleur plus grisâtre, moins brunâtre. Néanmoins quelques individus de Bogotá paraissent très proches et il faudrait un plus grand nombre d'individus pour être sûr qu'il n'existe pas quelques petites différences constantes.

317. Pterophanes temmincki (Boiss.).

Maraynioc: trois mâles de juillet et novembre 1891. Pariayacu: une femelle du 2 août 1892.

Un mâle adulte recueilli par M. Jelski à Maraynioc le 3 juin 1871 (du Musée Berlepsch) diffère des oiseaux de Bogotá et de l'Ecuador (Quito) par le plumage, en dessus et en dessous, beaucoup plus sombre ou d'un vert plus noirâtre, par les tectrices souscaudales bleuâtres, par le bec, les ailes et la queue plus longs, la queue plus étagée. Un oiseau de la Bolivie pas tout-à-fait adulte s'accorde avec les oiseaux de la Colombie.

318. Aglæactis caumatonota Gould.

Maraynioc: deux mâles adultes de juillet, du 15 décembre 1891, et du 18 janvier 1893. Pariayacu: un mâle du 28 janvier 1893. "Iris noir, bec et pattes noirs, mandibule inférieure d'un carné-jaunâtre à la base."

Al. 88-87¼, caud. 51½-49½, culm. 16¾-16½, caud. furca 8½-7½ mm.

Nos oiseaux s'accordent le mieux avec la description de l'*A. olivaceocauda* Lawr. (type de Matara, province d'Ayacucho). Le type de l'*A. caumatonota* Gld. est un jeune oiseau dont l'habitat était donné simplement comme "le Pérou." Probablement il n'y a pas lieu d'établir deux formes de cette espèce.

319. Boissonneaua mathewsi (Bourc.).

Garita del Sol: deux mâles, une femelle et un jeune d'août 1891. Culumachay: un mâle du 10 août 1892.

Il ne nous semble pas y avoir de différence constante entre les oiseaux du Pérou central, du Pérou du nord (localité typique) et de l'Ecuador.

320. Eriocnemis sapphiropygia Tacz.

Maraynioc: deux mâles adultes du 17 décembre 1891. Pariayacu: une femelle du 18 septembre 1892. "Bec et pattes noirs."

Al. 72, caud. 48, culm. 20, caud. furca 15 mm.

Cette espèce est alliée à l'*E. luciani*, mais diffère par le manque complet du bleu au front, par le piléum légèrement bronzé, par les côtés du cou moins dorés, par la queue moins fourchue, etc.

321. Spathura annæ Berl. et Stolzm.

Spathura annæ Berl. et Stolzm. Ibis, 1894, p. 398, descr. orig

S. peruana Tacz. (nec Gould) Orn. du Pérou, i. p. 327.

La Gloria, Chanchamayo, Garita del Sol, Vitoc: deux mâles adultes, une femelle adulte et trois jeunes mâles de février, juin, juillet et novembre 1891. "Iris noir, bec noir, pattes carnées."

Depuis la publication dans l'Ibis, Berlepsch a réuni une bonne série d'individus de la *S. annæ* de la Bolivie et a pu s'assurer que les points de distinction indiqués dans notre article (*l. c.*) sont tout-à-fait fondés et constants. En effet les mâles adultes de la *S. annæ* se distinguent au premier coup d'œil par le manque complet du blanc à la base des plumes du cou inférieur et de la poitrine, le manque du mélange blanc-grisâtre au ventre, les tectrices souscaudales d'un vert uniforme sans bordures blanches-roussâtres, les rectrices externes généralement plus longues, enfin les spatules plus petites.

322. Adelomyia melanogenys (Fras.).

Une paire de la Garita del Sol des 1 et 20 juillet 1891.

♂. Al. 54½,	caud. 37½,	culm. 14 mm.
♀. „ 48,	„ 31½,	„ 14 „

Ces oiseaux s'accordent avec une mâle de Huasampilla (coll. Whitely) du Musée Berlepsch (*A. chlorospila* Gld.), et diffèrent un peu des oiseaux de Bogotá par les parties inférieures et les points des rectrices externes plus roussâtres, moins blanchâtres et par les taches gulaires plus larges et d'un vert plus clair moins brunâtre. Néanmoins quelques individus de Bogotá sont tellement proches des oiseaux du Pérou central qu'il serait difficile de les en distinguer.

323. HELIANGELUS AMETHYSTICOLLIS (Lafr. et d'Orb.).

Maraynioc: une paire d'oiseaux du 17 décembre 1891, et quatre paires de juillet, août et octobre 1892, et de janvier et juin 1893. "Bec et pattes noirs."

Les mâles envoyés diffèrent des mâles de la Bolivie par le bec plus court, la bande pectorale d'un roussâtre plus pâle ou plus blanchâtre et le milieu de l'abdomen moins roussâtre, le croupion sans éclat cuivreux. Les femelles diffèrent aussi des femelles de la Bolivie par la bande pectorale plus blanchâtre et la gorge d'un roux plus clair (au lieu d'un brun obscur), le milieu du ventre d'un fauve grisâtre au lieu d'un roux clair, ainsi que par le bec plus court.

Deux mâles des environs des Cuzco (coll. O. Garlepp) sont tout-à-fait identiques aux oiseaux boliviens.

324. METALLURA PHŒBE JELSKII (Cab.).

Tarma: un mâle adulte du 15 décembre 1891; un mâle, deux femelles et deux oiseaux jeunes de Tambo de Aza, d'octobre et de novembre 1892, de Tapo de décembre 1892, et de Queta de juillet 1893.

♂.	Al. 77,	caud. $56\frac{1}{2}$,	culm. $17\frac{1}{2}$,	caud. furca	$8\frac{3}{4}$	mm.
♀.	„ $66\frac{1}{2}$,	„ $47\frac{1}{2}$,	„ $16\frac{1}{2}$,	„ „	4	„

Les oiseaux de Tarma appartiennent sans doute à la forme décrite par le docteur Cabanis sous le nom de *M. jelskii*. Les mâles adultes se distinguent des individus occidentaux (*M. phœbe* typique ?) par le plumage généralement d'un noir mat très intense, tandis que les individus de l'occident présentent le plumage d'un noir-brun plus ou moins bronzé avec un reflet violâtre qui se manifeste surtout au-dessus de la tête. Les oiseaux de Huamachuco (Pérou du nord-ouest) recueillis par Baron ont le plumage aussi intense que les échantillons de Tarma, mais ils s'accordent avec les oiseaux de la province d'Ayacucho par le reflet bronzé du piléum. Ils sont pour ainsi dire intermédiaires entre la *M. phœbe* et la *M. ph. jelskii.*

325. METALLURA EUPOGON Cab.

Maraynioc: trois mâles et une femelle adulte de juillet, novembre et décembre 1891. Pariayacu: une femelle du 7 janvier 1893. "Bec et pattes noirs."

♂ ad. Al. 65, caud. $42\frac{1}{2}$, culm. 13, caud. furca 2 mm.

326. Metallura smaragdinicollis (Lafr. et d'Orb.).

Maraynioc : trois paires de novembre et décembre 1891. Pariayacu : une paire de novembre 1892 et de janvier 1893.

327. Chalcostigma stanleyi (Bourc. et Muls.).

Rhamphomicron stanleyi Tacz. Orn. du Pérou, i. p. 345.

Maraynioc : un mâle adulte du 19 décembre 1891. "Iris noir, bec et pattes noirs."

L'oiseau de Maraynioc diffère un peu des oiseaux typiques de l'Ecuador par la pointe améthyste de la parure gulaire moins développée et un peu plus pâle, et par les parties inférieures du corps plus sombres, d'un brun enfumé légèrement lavé de violâtre au lieu d'être lavé et mêlé d'un vert olive. Par cette coloration des parties inférieures du corps notre oiseau se rapproche un peu des oiseaux boliviens (*Ch. stanleyi vulcani* Gld.) qui néanmoins présentent un mélange violâtre plus fort. Un oiseau d'Ocobamba près de Cuzco (coll. O. Garlepp) s'accorde tout-à-fait avec les oiseaux boliviens. Avant de séparer l'oiseau de Maraynioc comme sous-espèce il faudrait comparer plusieurs échantillons de cette localité.

328. Chalcostigma olivaceum (Lawr.).

Rhamphomicron olivaceus Tacz. Orn. du Pérou, i. p. 347.

Tuhan : un mâle adulte du 29 octobre 1892. Maraynioc : un mâle du 29 octobre 1892.

Al. 89, caud. 63½, culm. 12¼, caud. furca 12½ mm.

L'espèce a été décrite comme provenant de la Paz en Bolivie, où jusqu'à présent elle n'a pas été retrouvée.

329. Chalcostigma ruficeps aureo-fastigatum Hart.

Chalcostigma ruficeps aureo-fastigatum Hartert, Nov. Zool. vol. vi. (1899) p. 74 (descr. orig. Loja).

Rhamphomicron ruficeps Tacz. Orn. du Pérou, i. p. 348.

Maraynioc, Tambo de Aza : un jeune mâle du 24 octobre 1892.

Ce jeune oiseau appartien probablement à la forme décrite nouvellement par M. Hartert de l'Ecuador et du Pérou septentrional (Cutervo).

330. Cyanolesbia mocoa smaragdina (Gld.).

Cynanthus mocoa Tacz. Orn. du Pérou, i. p. 334.

Vitoc, Garita del Sol : un mâle adulte du 1 août 1891.

Al. 70½, caud. rectr. ext. 109, submed. 63½, caud. furca 79, culm. 12 mm.

L'oiseau envoyé ne diffère des oiseaux boliviens recueillis par M. G. Garlepp que par le bec sensiblement plus court. Un mâle de Huasampilla, Pérou du sud (coll. Whitely), l'a aussi long que les boliviens et un mâle adulte de l'Ecuador oriental (*C. mocoa* typique) est intermédiaire sous ce rapport. La *C. mocoa smaragdina* de la Bolivie et du Pérou diffère de la *C. mocoa* typique de

l'Ecuador oriental (et de la Colombie oriental ?) par la queue un peu plus longue, par la parure gulaire bleue plus pâle et moins violâtre, enfin par le vert du dos et des côtés du piléum plus pâle et jamais noirâtre sous certain jour.

331. Polyonymus caroli (Bourc.).

Sappho caroli Tacz. Orn. du Pérou, i. p. 337.

Tapo : une femelle adulte du 27 décembre 1892.

Al. 57, rectr. ext. $45\frac{1}{2}$, submed. $40\frac{1}{2}$, culm. $18\frac{3}{4}$ mm.

Cette femelle ressemble à l'oiseau décrit par Taczanowski comme jeune mâle et diffère du mâle adulte par la gorge blanche ornée sur chaque plume d'une plaque rouge de feu doré, tandis que chez le mâle adulte la gorge est d'un rouge grenat uniforme et non interrompu par des bordures blanches latérales et par les bases blanches comme c'est les cas chez la femelle. La barbe externe de la rectrice la plus externe et la pointe de la barbe interne sont d'un blanc roussâtre.

332. Psalidoprymna juliæ Hartert.

Psalidoprymna juliæ Hartert, Nov. Zool. vi. (1899) p. 75 ("Northern Peru").

Tapo : trois mâles adultes des 24 et 27 décembre 1892.

Al. 63–$61\frac{1}{2}$, caud. 127–$111\frac{3}{4}$, culm. $13\frac{3}{4}$–$13\frac{1}{2}$, caud. furca 101–$85\frac{1}{4}$ mm.

Cette espèce tout-à-fait distincte nommée par nous provisoirement *Lesbia juliæ* (P. Z. S. 1896, p. 323) a été décrite sous ce nom par M. Hartert d'après des exemplaires recueillis par M. O. T. Baron dans le nord du Pérou.

Les échantillons de Tapo ne diffèrent des oiseaux de Cajabamba (coll. Baron) que par le bec et la queue un peu plus longs.

Il est à remarquer que nous avons eu l'intention de dédier cette espèce à la comtesse Julie Branicka, épouse du comte Ladislas Branicki.

333. Calliphlox amethystina (Gml.).

La Merced : un mâle adulte du 19 juillet 1890.

Al. $36\frac{1}{4}$, caud. $34\frac{1}{4}$, culm. 15, caud. furca $17\frac{1}{2}$ mm.

Ce mâle unique diffère des mâles du Brésil méridional par le bec et les ailes plus longs et le rouge de la parure gulaire plus clair et moins violâtre. Comme il y a une variation individuelle considérable chez la *C. amethystina*, il faudrait une série d'exemplaires pour s'assurer de la constance des points différentiels.

334. Heliothrix auriculatus (Nordm.).

? *Heliothrix auritus* Tacz. Orn. du Pérou, i. p. 363.

La Merced : un mâle adulte et un jeune mâle de janvier et septembre 1891. "Bec et pattes noirs."

♂ ad. Al. 64, caud. $43\frac{1}{2}$, culm. $16\frac{1}{2}$ mm.

Le mâle adulte (en mue) ne diffère des oiseaux du Brésil méridional que par le vert du menton un peu plus étendu en bas,

mais pas aussi étendu qu'il ne paraît en être le cas chez le *H. phainolæma* Gould du "Rio Napo."

Le jeune mâle possède encore la queue longue comme la femelle, mais il présente la gorge et le haut de la poitrine d'un blanc pur sans taches brunes-verdâtres. Les plumes ornementales bleues-violettes de la région auriculaire commencent déjà à se développer.

Espèce nouvelle pour la faune péruvienne.

335. Acestrura mulsanti (Bourc.).

Garita del Sol : deux mâles adultes de juin et juillet 1891.

Il n'y a pas de différence entre ces oiseaux et les individus de la Colombie. Peut-être les échantillons du Pérou et de la Bolivie ont-ils les ailes généralement un peu plus courtes.

336. Klais guimeti merritti (Lawr.).

Klais guimeti Tacz. Orn. du Pérou, i. p. 364.

Borgoña : cinq mâles d'avril 1891.

Al. 51, caud. $29\frac{1}{2}$, culm. $11\frac{1}{4}$ mm.

La forme du Pérou s'accorde le mieux avec celle de l'Amérique centrale (*cf.* Tacz. *l. c.*).

337. Lophornis regulus (Gould).

Lophornis delattrei Tacz. (nec Less.) Orn. du Pérou, i. p. 299.

La Borgoña : un jeune mâle et un jeune oiseau sans indication du sexe du 9 juin 1891. "Iris noir, bec noir à mandibule inférieure d'un carné-brunâtre à la base ; pattes noires."

Ces oiseaux appartiennent probablement à la forme *L. lophotes* Gld., décrite comme provenant du Pérou, mais on ne peut juger d'après des oiseaux non adultes.

Fam. Cypselidæ.

338. Chætura zonaris (Shaw).

La Merced : cinq femelles de juillet et août 1890. "Iris brun foncé."

♀. Al. 204, caud. $77\frac{1}{2}$, culm. 9, tars. $20\frac{1}{2}$ mm.

339. Chætura sclateri Pelz.

La Gloria : une femelle du 13 août 1890. "Iris brun foncé."

340. Cypseloides brunneitorques (Lafr.).

Chætura rutila Tacz. Orn. du Pérou, i. p. 229.

La Gloria : trois individus d'août 1890. "Iris noir."

La Merced : une femelle du 2 janvier 1891.

♂. Al. 128, caud. 50, culm. $5\frac{1}{2}$, tars. $10\frac{3}{4}$ mm.

♀ ♀. Al. $128\frac{1}{2}$–122, caud. 50–$45\frac{1}{2}$, culm. $6\frac{1}{2}$–$5\frac{1}{2}$, tars. $12\frac{1}{2}$–$10\frac{1}{2}$ mm.

Mr. Hartert (Cat. B. Brit. Mus. xvi. p. 494) dit : "Female without the rufous collar" ; mais nos trois femelles présentent le

collier roux aussi large que le mâle. Une femelle recueillie le 7 août s'accorde en tout avec le mâle, tandis que les autres femelles diffèrent par le roux de la gorge et de la poitrine à peine indiqué par quelques bordures d'un roux brun, et par les ailes et la queue plus courtes.

Le mâle de La Gloria ne diffère des mâles de Mapoto, Ecuador oriental, que par le roux plus intense et par le noir de l'abdomen plus pur. Le type venait de Bogotá.

Fam. Caprimulgidæ.

341. Caprimulgus ocellatus Tsch.

Antrostomus ocellatus Tacz. Orn. du Pérou, i. p. 215.

Garita del Sol: un mâle adulte du 20 juillet 1891. "Iris noir, bec noir, pattes d'un brun-carné."

342. Stenopsis longirostris (Bp.).

Stenopsis bifasciata Tacz. Orn. du Pérou, i. p. 221.

Maraynioc, Pariayacu: un mâle non complètement adulte du 10 juillet 1892. "Iris noir."

Al. 158½, caud. 118½, culm. 15½, tars. 16½ mm.

S'accorde avec un oiseau de Chicani, Bolivie, recueilli par M. Garlepp.

La *H. ruficervix* Scl. de la Colombie n'est probablement q'une sous-espèce de la *H. longirostris*. Elle n'en diffère que par les dimensions un peu plus petites (surtout la queue plus courte), les parties supérieures plus variées de roussâtre, les points roussâtres du piléum plus distincts et plus intenses, les bandes blanches des rémiges plus larges, et par d'autres petits détails de la coloration. Les oiseaux du Pérou méridional classifiés par M. Hartert sous la *H. ruficervix* appartiennent certainement à la *H. longirostris*.

343. Nyctidromus albicollis (Gml.)

La Merced: deux mâles de juillet et d'août 1890. "Iris brun foncé."

344. Hydropsalis torquata (Gml.).

La Merced: un mâle adulte du 28 juin 1891. Chontabamba: un jeune mâle du 13 septembre 1891. "Iris et bec noirs, pattes d'un brun grisatre."

Al. 166½, rectr. ext. 257½, subext. 153, culm. 12¼, tars. 18½ mm.

Espèce nouvelle pour la faune péruvienne. Le mâle envoyé ne diffère d'un mâle adulte de Bahia, Brésil, du Musée Berlepsch, que par les ailes un peu plus courtes, la queue beaucoup plus courte, l'abdomen plus blanchâtre et la bande rousse nucale moins vive.

Peut-être ces différences ne sont-elles qu'individuelles. En tout cas notre oiseau n'appartient pas à la *H. furcifera* (Vieill.) qui présente des couleurs plus pâles et des dimensions généralement plus grandes.

345. Hydropsalis climacocercus Tsch.

Hydropsalis trifurcata, Tacz. Orn. du Pérou, i. p. 224.

La Merced: quatre individus de juillet et août 1890, et un jeune mâle de 7 janvier 1891. "Iris noir, pattes d'un brun cendré."

346. Macropsalis kalinowskii Berl. et Stolzm.

Macropsalis kalinowskii Berl. et Stolzm. Ibis, 1894, p. 399, descr. orig. (Pariayacu).

Hydropsalis segmentata Tacz. (nec Cass.) Orn. du Pérou, i. p. 223.

Pariayacu près de Maraynioc: cinq mâles adultes et trois femelles des 26 octobre, 5 et 6 novembre, 12 décembre 1891, du 16 septembre 1892 et du 26 février 1893. "Iris noir, bec noir, pattes d'un brun-carné."

Malheureusement quand nous décrivimes cette forme sous la dénomination de *M. kalinowskii* il nous manquait des échantillons de la *M. segmentata* Cass. de Bogotá pour la comparaison. Depuis lors Berlepsch a reçu deux mâles de cette dernière espèce provenant des collections indiennes des environs de Bogotá qui prouvent que la différence entre la *M. kalinowskii* et la *M. segmentata* n'est pas aussi prononcée que nous l'avions supposé.

En effet les deux formes ne diffèrent presque *que dans le dessin des rectrices externes* chez les mâles adultes. Chez la *M. kalinowskii* les barbes internes de ces rectrices sont pourvues de bandes irrégulières blanchâtres dans toute leur longueur, occupant la moitié de la barbe vers la tige. Ces bandes manquent presque complètement chez la *M. segmentata* ou ne se manifestent que dans le tiers apical de ces rectrices chez quelques individus (les plus jeunes?). Il paraît aussi que chez la *M. kalinowskii* les barbes externes de ces rectrices sont d'un blanc plus pur et jamais tachetées de roussâtre, ce qui se trouve quelquefois chez l'autre espèce. En outre chez la première ces rectrices sont plus atténuées, à barbe interne plus étroite dans le tiers apical. L'abdomen paraît plus noirâtre, moins roussâtre que chez la *M. segmentata*. La bande subterminale blanchâtre des rectrices les plus courtes (sauf les médianes) qui se manifeste chez la *M. kalinowskii*, est à peine indiquée au milieu de la barbe interne des deux paires subexternes chez la *M. segmentata*. Enfin la première est un peu plus petite, à queue un peu plus courte.

Les autres points de différence indiqués par nous ne paraissent pas être constants.

347. Lurocalis rufiventris Tacz.

La Gloria: deux femelles des juillet et d août 1890. "Iris noir."

Les femelles s'accordent dans tous les détails avec les oiseaux typiques.

Fam. PICIDÆ.

348. COLAPTES PUNA Cab.

Ingapirca: cinq individus d'avril et juin 1890. Maraynioc: un mâle ad. et une femelle jeune de février 1893. "Iris jaune olivâtre."

Les types du Muséum de Berlin venaient de la vallée de Tauli, Pérou occidental.

349. HYPOXANTHUS RIVOLII BREVIROSTRIS (Tacz.).

Maraynioc: une femelle du 18 novembre 1891. Un mâle et deux femelles de juillet et août 1892 et de mai 1893.

350. CHLORONERPES CHRYSOGASTER, sp. nov.

Chl. Chl. canipileus *et* Chl. gularis *dictis affinis, differt abdomine sulphureo-aureo-flavo fere immaculato (nec viridescenti-flavo, olivaceo-viridi fasciato), dorso alisque extus magis aurantio-brunneis minus olivaceis, pectore aurantio-brunneo tincto nec olivaceo-viridi, uropygio fere sicut in* Chl. gularis *dicto flavescente crebre fasciato, sed magis rubro tincto.*

♂ ♂. Al. 128,	caud. $83\frac{1}{2}$–78,	culm. $26\frac{3}{4}$–$24\frac{3}{4}$,	tars. $22\frac{1}{2}$	mm.
♀. „ 129,	„ $83\frac{1}{2}$,	„ $27\frac{3}{4}$,	„ 21	„

Hab. in Peruvia centrali: La Gloria et Garita del Sol.

Typus in Mus. Branicki: ♂ ad. La Garita del Sol, 29 VI. 1891. T. Kalinowski, legit no. 1282.

La Gloria: une femelle adulte du 7 août 1890. "Iris brun rougeâtre." Garita del Sol: deux mâles adultes de juin et juillet 1891, et deux autres des mars et d'avril 1893.

Les oiseaux recueillis par M. Kalinowski se distinguent au premier coup d'œil des oiseaux de la Bolivie (*Chl. canipileus* typique), dont Berlepsch possède une bonne série, par l'abdomen d'un jaune de soufre doré presque sans macules, tandis que chez le *Chl. canipileus* il est plus verdâtre et rayé régulièrement de bandes d'un vert-olive obscure. Il en est de même pour les tectrices souscaudales. Chez la nouvelle espèce le dos et les ailes en dessus sont d'un brun-olive orangé très-vif au lieu d'un olive-verdâtre; la poitrine fortement lavée d'un brun-orangé au lieu de verdâtre, enfin le croupion plus jaunâtre à bandes transversales plus distinctes et lavé fortement de rouge de sang.

C'est un fait curieux que les oiseaux boliviens (*Chl. canipileus*) ressemblent plutôt aux oiseaux de la Colombie et du Vénézuela (*Chl. rubiginosus*) qu'aux péruviens.

351. CHLORONERPES LEUCOLÆMUS (Malh.).

Chanchamayo: une femelle d'août 1890. La Gloria: une femelle du 20 janvier 1891. "Iris brun foncé."

352. MELANERPES CRUENTATUS (Bodd.).

La Gloria: une paire d'août 1890. "Iris rouge-orangé."

353. DENDROBATES FUMIGATUS (Lafr. et D'Orb.).

Garita del Sol: une femelle du 4 août 1891. Vitoc: un mâle du 7 février 1893.

354. DENDROBATES MALHERBEI PECTORALIS, subsp. nov.

D. D. malherbei *dicto (ex Ecuadoria) affinis, differt corpore supra subtusque obscuriore olivaceo, fasciis in pectore (semper ut videtur) magis arcuatis, interdum cordiformibus vel maculiformibus, rostro pro usu longiore, alis vero brevioribus.* Fœminæ *pileo sicut in* D. malherbei *dicto brunneo-olivaceo.* Mas *quoad colores* D. nigriceps *dicto ex Bolivia maxime affinis ut videtur, sed rostro breviore.*

♀ ♀ ad. Al. 96½–92½, caud. 71–64, culm. 24½–22½, tars. 22¾–19½ mm.

Hab. in Peruvia centrali; Maraynioc, altitudo 13,000 pedum.

Typus in Mus. Branicki et Mus. Berlepschi.

Maraynioc, Pariayacu: deux femelles adultes des 6 et 8 août, un jeune mâle du 30 août 1892, et une jeune femelle du 26 octobre 1891. "Iris rouge foncé, bec brun-corne, à mandibule inférieure blanchâtre, pattes d'un gris plombé."

Cette forme nouvelle, dont M. Kalinowski n'a malheureusement envoyé que des femelles et un mâle très-jeune, paraît intermédiaire entre le *D. malherbei* Scl.[1] de l'Ecuador et le *D. nigriceps* d'Orb. de la Bolivie. La femelle a le sommet de la tête d'un olive foncé noirâtre comme les femelles de l'Ecuador et non noir intense comme les femelles de la Bolivie. La couleur du dessus et du dessous du corps est beaucoup plus claire que chez les oiseaux de l'Ecuador mais ressemble à celle des oiseaux boliviens. Néanmoins il y a une différence considérable dans le dessin de la poitrine: tandis que chez tous les individus de l'Ecuador et de la Bolivie examinés par nous les bandes blanchâtres de la poitrine sont tout-à-fait régulières et d'une largeur uniforme dans toute leur étendue, chez les oiseaux de Maraynioc elles sont échancrées au milieu vers la base de la plume et deviennent plus étroites vers les côtés. Une femelle adulte du 28 octobre a même les bandes réduites à des taches cordiformes, ce qui donne à la poitrine une apparence tout-à-fait différente de celle de l'abdomen, qui est rayé régulièrement de bandes d'un blanc jaunâtre et paraît plus clair.

La longueur du bec paraît intermédiaire entre celle du *D. malherbei* et celle du *D. nigriceps*. Les ailes sont plus courtes que chez les autres formes.

355. DENDROBATES VALDIZANI Berl. et Stolzm.

Dendrobates valdizani Berl. et Stolzm. Ibis, 1894, p. 401 (descr. orig.).

[1] L'espèce écuadorienne confondue par MM. Sclater et Hargitt avec le *D. nigriceps* d'Orb. de la Bolivie en est tout-à-fait distincte; elle est plus petite, surtout à bec plus court, et présente une coloration plus claire en dessus et en dessous. Le mâle a le rouge du piléum plus clair et la femelle y présente une couleur brun-olive un peu noirâtre au lieu d'un noir intense.

Huacras, Vitoc: un mâle unique du 14 décembre 1892. "Iris brun foncé."

356. Dendrobates hæmatostigma (Malh.).

Chloronerpes hilaris Cab. et Heine, Tacz. Orn. du Pérou, iii. p. 81.

La Gloria, août 1890. } Trois individus.
La Merced, septembre 1890. } "Iris brun foncé."

Garita del Sol: deux mâles adultes, un jeune mâle et une femelle.

Les oiseaux péruviens ont les ailes et la queue un peu plus longues et la nuance des raies foncées des parties inférieures plus brunâtres et moins olivâtres que les oiseaux de la Bolivie. Il paraît que M. Malherbe a fondé son *M. hæmatostigma* sur les oiseaux recueillis par Natterer à Borba et Marabitanas. Peut-être qu'on pourraît séparer les oiseaux péruviens sous la dénomination de *D. hæmatostigma hilaris* (Cab. et Hein.).

357. Campephilus melanoleucus (Gm.).

Borgaña: une femelle du 23 avril 1891. "Iris jaune olivâtre, bec blanc brunâtre, pattes d'un gris olivâtre."

Les oiseaux du Pérou central (en outre un mâle adulte recueilli à Callanga près de Cuzco par M. O. Garlepp) présentent des dimensions plus petites que les individus de Cayenne et de Bogotá du Musée Berlepsch. Ils ont aussi le blanc des tectrices sousalaires et des barbes internes des rémiges plus lavé de jaunâtre.

358. Campephilus pollens (Bp.).

Maraynioc, Calamachay: un mâle et deux femelles adultes du 24 juillet 1892.

♂.	Al. $176\frac{1}{2}$,	caud. 127,	culm. 50,	tars. $35\frac{1}{2}$ mm.
♀.	" 176,	" 127,	" $49\frac{1}{2}$,	" $35\frac{1}{2}$ "

Ces individus ne diffèrent des échantillons de Bogotá du Musée Berlepsch que par les ailes et la queue plus courtes. C'est probablement un caractère individuel.

Espèce nouvelle pour la faune péruvienne.

359. Ceophlœus lineatus (L.).

La Merced: un oiseau du 25 août 1890. "Iris blanche."

La Gloria: un mâle du 18 janvier 1891. "Iris blanc, bec brun pâle, pattes d'un plombé clair."

360. Picumnus jelskii Tacz.

Garita del Sol: deux mâles adultes, une femelle adulte et un jeune de juillet et septembre 1891. "Iris brun foncé, bec brun corné à mandibule supérieure sur les côtés—et la mandibule inférieure en entier—d'un plombé bleuâtre; pattes d'un plombé bleuâtre."

361. Picumnus punctifrons Tacz.

La Merced: une paire de juillet et septembre 1890. "Iris brun foncé." Deux mâles et une femelle de mars et avril 1891.

Fam. Alcedinidæ.

362. Ceryle amazona (Lath.).

La Merced: deux mâles de janvier et mars 1891. "Iris, bec et pattes noirs."

363. Ceryle americana (Gm.).

Ceryle americana et *C. cabanisi* part., Tacz. Orn. du Pérou, iii. pp. 104, 105.

La Merced: trois individus de juillet et septembre 1890, "iris brun foncé," et deux mâles adultes de décembre 1890 et mars 1891.

Fam. Momotidæ.

364. Prionirhynchus platyrhynchus (Leadb.), subsp. nov. ?

Specimina e Peruvia centrali: *rectricibus mediis omnino vexillis præditis nec spatulatis, mento rufo-brunneo gulæ concolore, nec cærulescente.*

♂. Al. 120, caud. 201½, culm. 38, tars. 18 mm.

La Merced: une paire du 1 septembre 1890. "Iris presque noir."

Borgoña: deux mâles adultes de mai 1891.

L'oiseau typique de Leadbeater est dit être venu du Brésil, d'où l'espèce n'est pas mentionnée par les auteurs contemporains. Dans la planche de Jardine et Selby, faite d'après l'oiseau typique, il est représenté à rectrices médianes spatulées, tandis que les oiseaux recueillis par Kalinowski, de même que deux échantillons de la Bolivie envoyés par M. Garlepp, ont les rectrices médianes barbées dans toute leur longueur et ne présentant pas de spatules. D'autre part deux oiseaux de Costarica et de Veragua du Musée Berlepsch ont les rectrices médianes spatulées. Peut-être est-ce un cas analogue à celui du *Momotus martii* et du *M. semirufus* (voir Berl. Journ. f. Orn. 1889, p. 308).

Les oiseaux du Pérou central diffèrent de ceux de la Bolivie ayant le menton roux-brun concolore à la gorge au lieu d'un bleu verdâtre. En cas qu'il faille séparer les oiseaux péruviens du vrai *P. platyrhynchus* nous proposons de les nommer *P. p. pyrrholæmus* Berl. et Stolzm.

365. Momotus æquatorialis chlorolæmus, subsp. nov.

M. M. æquatorialis *dicto simillimus, sed corpore supra subtusque pallide cærulescenti-viridi (nec saturate rufescenti-olivaceo-viridi), collo posteriore vix rufescente lavato, colore cincturæ pilei pallidius cæruleo, gula magis cærulescente lavata, necnon plumis latis pectoralibus nigris magis cærulescente marginatis distinguendus.*

Hab. in Peruvia centrali or. (Ocobamba prope Cuzco, La Gloria, Garita del Sol).

Typus in Mus. Berlepsch (♂. Ocobamba, O. Garlepp legit no. 131).

La Gloria (janvier 1891). Garita del Sol (juillet et août 1891): une paire d'oiseaux adultes et un jeune mâle; deux femelles de Garita del Sol et de Pariayacu de juillet 1892 et de février 1893. "Iris rouge, bec noir, pattes brunes."

366. Momotus momota ignobilis (Berl.).

Momotus brasiliensis Lath.; Tacz. Orn. du Pérou, iii. p. 108.

? *Momotus bartletti* Sharpe, Cat. Birds Brit. Mus. xvii. p. 320.

La Merced: trois individus de juillet 1890. "Iris rouge."

♂. Al. $135\frac{1}{2}$, caud. 247, culm. $39\frac{1}{2}$, tars. 26 mm.

S'accordent avec les oiseaux de Yurimaguas que Berlepsch a nommés *brasilensis ignobilis*, seulement à bec un peu plus court.

367. Urospatha martii (Spix).

La Merced: une femelle du 1 septembre 1890.

Fam. Trogonidæ.

368. Pharomacrus antisianus (D'Orb.).

Garita del Sol: un mâle du 8 avril 1893.

Al. $191\frac{1}{2}$, caud. $164\frac{1}{2}$, culm. $19\frac{3}{4}$, tars. $15\frac{1}{2}$ mm. "Iris rouge-cerise, bec jaune sale, pattes d'un gris olivâtre."

S'accordent avec les individus de la Bolivie recueillis par M. G. Garlepp.

369. Pharomacrus auriceps (Gould).

Garita del Sol: un mâle adulte du 4 septembre 1891 et une femelle du 22 septembre 1892.

370. Trogon personatus Gould.

Garita del Sol: une paire du 20 novembre 1891. Maraynioc: deux mâles et une femelle d'octobre et novembre 1892 et de février 1893.

371. Trogon collaris Vieill.

La Gloria: un mâle adulte d'août 1890 et trois mâles adultes de janvier et février 1891. La Merced: un mâle adulte de septembre 1890 et un mâle adulte de mars 1891. "Iris brun foncé, bec jaune."

Les échantillons recueillis par M. Kalinowski s'accordent le mieux avec un individu de l'Ecuador oriental (Musée Berlepsch) et ne diffèrent que par les lignes noires et blanches des tectrices sousalaires plus larges, la tête et le cou d'un vert plus jaunâtre ou doré au lieu de bleuâtre, les ailes un peu plus courtes, la queue plus longue. Il paraît que les oiseaux de l'occident ont le rouge

de l'abdomen écarlate au lieu de rosé comme chez les oiseaux de Cayenne.

372. TROGON MERIDIONALIS RAMONIANUS (Dev. et Des Murs).

La Merced: une femelle du 31 mars 1891. "Iris brun foncé, bec brun en dessus, la mandibule inférieure et les côtés de la mandibule supérieure à la base d'un gris plombé ; pattes brunes."

Fam. GALBULIDÆ.

373. GALBULA TOMBACEA CYANESCENS (Deville).

Galbula tombacea Tacz. Orn. du Pérou, iii. p. 115.

La Gloria et La Merced: sept individus de juillet à septembre 1890. La Merced: une femelle et un oiseau sans indication de sexe, janvier et mars 1891. "Iris brun foncé."

	Long. tot.	Enverg.	Aile.	Queue.	Culm.	Tars.
♂ ♂.	248, 249	242, 283	83, 82	99, 96½	55, 53	11½ mm
♀.	244	286	80	94	51½	12½ „

Ces oiseaux appartiennent à la forme à front d'un vert métallique et non brunâtre. Il nous paraît que la description de M. Deville dans la Rev. et Mag. de Zool. 1849, p. 56, a rapport à cette forme et non à celle à front brunâtre, car on y lit "la tête d'un vert bleu." Mais Deville a recueilli des individus des deux formes, comme l'a constaté M. Sclater (Jac. & Puffb. p. 25). D'autre part M. Spix a décrit sa *Galbula tombacea* comme ayant le front brun ("fronte brunnescente").

Fam. BUCCONIDÆ.

374. BUCCO STRIOLATUS Pelz.

La Merced : un mâle adulte du 4 septembre 1890. "Iris d'un ochreux pâle."

Al. 82, caud. 68½, culm. 26½, tars. 18 mm.

375. MALACOPTILA FULVIGULARIS MELANOPOGON, subsp. nov.

Malacoptila fulvogularis Tacz. Orn. du Pérou, iii. p. 132.

M. M. fulvigularis *dictæ simillima, differt linea frontali fasciculisque rictalibus pure albis nec fulvescenti-albis, plumis mentalibus retrorsum curvatis nigrescentibus nec fulvis, colore gulæ intensius rufescente, striis pectoralibus albis magis fulvescente tinctis, necnon tectricibus alarum superioribus magis conspicue fulvo striatis et apicatis.*

♂.	Al. 94½,	caud. 89,	culm. 25½,	tars. 17½ mm.
♀.	„ 95½,	„ 95,	„ 27½,	„ 20½ „

Hab. in Peruvia centrali : Garita del Sol et Maraynioc.

Typus in Mus. H. v. Berlepsch : ♂ La Garita (T. Kalinowski, legit no. 1330).

Garita del Sol : deux mâles et une femelle de juillet 1891.

"Iris rouge, bec noir, pattes d'un gris olivâtre." Maraynioc Tendalpata : une femelle du 27 avril 1893.

Comparés aux les oiseaux typiques de la Bolivie, les péruviens diffèrent par la ligne frontale et les fascicules aux côtés de la gorge d'un blanc pur au lieu d'un blanc roussâtre, par les poils recourbés du menton noirâtres au lieu d'un roussâtre clair, par les stries pectorales blanches plus distinctement lavées de roussâtre, enfin par les tectrices sousalaires plus variées et striées de roussâtre.

376. MONASA PERUANA Scl.

La Merced : une paire d'août et de septembre 1890. "Iris brun, bec rouge miniacé."

La Gloria : une femelle du 6 février 1891.

377. CHELIDOPTERA TENEBROSA (Pall.).

La Merced : trois mâles de juillet et de septembre 1890, et un mâle du 3 avril 1891. "Iris noir."

S'accordent avec les oiseaux de la Guyane britannique.

Fam. CUCULIDÆ.

378. PIAYA CAYANA NIGRICRISSA (Scl.).

La Gloria : une paire de juillet et d'août 1890. "Iris rouge-cerise, bec jaune verdâtre."

379. PIAYA RUTILA (Ill.).

La Merced : une femelle du 14 janvier 1891. "Iris rouge, tout de l'œil rouge foncé, bec jaune olivâtre, pattes brunes."

Al. 115½, caud. 173, culm. 21½, tars. 28½ mm.

L'oiseau envoyé a les ailes et la queue plus longues que chez tous les oiseaux de Surinam, Trinidad, Orénoque, Bogotá et de l'Ecuador examinés par nous. Néanmoins une femelle de l'Orénoque n'est pas trop différente sous ce rapport.

380. CROTOPHAGA ANI L.

La Merced : deux mâles du 20 août 1890, "iris brun foncé" ; et deux mâles de mars et avril 1891.

Fam. CAPITONIDÆ.

381. CAPITO GLAUCOGULARIS Tsch.

Garita del Sol : trois mâles et cinq femelles de juin, juillet, août et octobre 1891, et de mars et avril 1893. "Iris rouge, bec et pattes d'un vert olivâtre."

Fam. RHAMPHASTIDÆ.

382. RHAMPHASTOS AMBIGUUS Sw.

Trois mâles de Borgoña de janvier 1891, et de La Gloria de février 1891.

383. Andigena hypoglaucus (Gould).

Maraynioc : deux mâles adultes du 15 novembre 1891, un mâle et deux femelles de Pariayacu et de Culumachay d'août et octobre 1892.

384. Selenidera langsdorffi (Wagl.).

Borgoña : une paire d'avril et mai 1891.

♂. "Iris vert olivâtre, bec noir, les côtés de la mandibule supérieure à la base et la plus grande partie de la mandibule inférieure d'un olive jaunâtre sale ; les parties nues autour de l'œil d'un vert bleuâtre ; pattes d'un bleu verdâtre sale.

♀. "Iris vert olivâtre, bec noir, les côtés de la mandibule supérieure à la base et la plus grande partie de la mandibule inférieure d'un vert bleuâtre sale teintées de jaune ; parties nues autour de l'œil d'un vert bleuâtre tirant sur le jaunâtre ; pattes d'un vert bleuâtre."

385. Aulacorhamphus derbianus (Gould).

La Gloria (janvier 1891). }
Garita del Sol (août 1891). } Deux paires.

"Iris rouge brunâtre ; bec noir, rouge à la base et à l'extrémité ; à la base même il y a une ligne blanche ; pattes d'un plombé grisâtre teinté de verdâtre."

386. Aulacorhamphus cæruleo-cinctus (Tsch.).

Garita del Sol : trois mâles et une femelle de juillet et septembre 1891, et de Garita del Sol du 17 avril 1893. "Iris jaune blanchâtre, bec plombé corné plus clair à la base ; pattes d'un plombé olivâtre."

387. Aulacorhamphus atrocularis (Sturm).

La Merced. }
La Gloria. } Deux femelles de janvier et février 1891.

"Iris d'un rouge-brique brunâtre ; bec noir blanc à la base, d'un jaune olivâtre sur l'arête dorsale ; pattes d'un plombé olivâtre."

Fam. Psittacidæ.

388. Leptosittaca branickii Berl. et Stolzm.

Leptosittaca branickii Berl. et Stolzm. Ibis, 1894, p. 402, pl. xi. (descr. orig.).

Maraynioc, Culumachay, Pariayacu et Huarmipacha : deux mâles adultes, quatre femelles adultes, et un jeune (23 juillet), recueillis les 6 et 23 juillet 1892, 2 mars, 27 avril, 15 juin et 15 novembre 1893. "Iris rouge ou rouge ochracé et rouge sale, bec d'un gris corné sale, pattes brunâtres."

389. Conurus mitratus Tsch.

La Merced : une paire du 1 septembre 1890. Garita del Sol :

une paire du 24 avril 1893. "Iris jaune, bec blanc jaunâtre, pattes carnées."

390. CONURUS LEUCOPHTHALMUS (Müll.).

Conurus guianensis Tacz. Orn. du Pérou, iii. p. 199.

La Merced: une femelle du 12 avril 1891. "Iris, l'anneau extérieur orangé rosâtre, l'intérieur mince d'un gris bleuâtre; bec blanc jaunâtre sale; parties nues autour de l'œil d'un cendré brunâtre; pattes d'un gris brunâtre."

391. PYRRHURA RUPICOLA (Tsch.).

Conurus rupicola Tacz. Orn. du Pérou, iii. p. 201.

La Gloria: trois individus d'août 1890, un mâle et trois femelles de janvier et février 1891.
La Merced: janvier 1891.
Garita del Sol: juin 1891.
"Iris brun foncé."

392. BOLBORHYNCHUS ANDICOLA (Finsch).

Maraynioc: trois femelles de décembre 1891. Pariayacu: un mâle du 22 juillet 1892. "Iris brun foncé, bec jaune olivâtre sale, pattes d'un jaune sale."

393. CHRYSOTIS MERCENARIA (Tsch.).

La Gloria. } Trois individus d'août 1890. "Iris rouge."
La Merced. }
La Gloria (janvier). } Deux paires.
Garita del Sol (juillet). }

394. PIONUS MENSTRUUS (L.).

La Merced: un mâle du 29 juillet 1890. "Iris brun."

395. PIONUS TUMULTUOSUS (Tsch.).

Vitoc (Tendalpata): deux mâle adultes du 27 avril 1893. "Iris brun foncé, bec jaune, la cire grise, les parties nues autour de l'œil noires enfumées, pattes d'un gris sale."

Fam. STRIGIDÆ.

396. BUBO VIRGINIANUS MAGELLANICUS (Gm.).

Ingapirca: un mâle du 9 juin 1890. Tarma: un mâle du 16 juillet 1893. "Iris jaune orangé, bec et ongles noirs."

397. MEGASCOPS CHOLIBA (Vieill.)[1].

Garita del Sol: un mâle adulte du 6 juillet 1891. "Iris brun foncé, bec plombé bleuâtre, pattes d'un carné pâle."
Al. 202½, caud. 106, culm. 16½, tars. 34 mm.
Cet oiseau à dimensions assez grandes présente la phase brune

[1] Berlepsch a trouvé que le nom "*brasilianus*" de Gmelin, basé surtout sur le "Caburé" de Marcgrave, s'applique réellement au *Glaucidium ferox*, et non à l'espèce de *Megascops* qui jusqu'à présent a porté ce nom.

noirâtre. Le *Megascops* qui habite le Pérou oriental et l'Amazone supérieur (Yquitos) paraît identique à l'oiseau du Paraguay (*M. choliba* typique).

398. PULSATRIX MELANONOTA (Tsch.).

La Gloria (janvier). } Deux femelles adultes et
La Merced et Borgoña (avril 1891). } une jeune femelle.

"Iris noir, bec jaune olivâtre, pattes d'un jaune sale."

Ces oiseaux s'accordent tout-à-fait avec la description et la figure données par Tschudi. La description dans l'Ornithologie du Pérou par Taczanowski (i. p. 184), faite d'après un oiseau du Brésil, ne se rapporte pas à l'espèce de Tschudi, mais à une forme bien distincte.

399. GLAUCIDIUM JARDINEI Bp.

Maraynioc, Pariayacu, et Culumachay: deux jeunes mâles du 8 juillet 1892.

Al. $98\frac{1}{2}$-97, caud. $65\frac{1}{2}$, culm. $11\frac{3}{4}$-$11\frac{1}{4}$, tars. $19\frac{1}{2}$ mm.

Ces oiseaux diffèrent des oiseaux de jeune âge de l'Ecuador en ce qu'ils présentent de taches ou macules roussâtres sur la tête plus larges, par les tectrices auriculaires rayées de bandes noirâtres, par les taches roussâtres du dos plus grandes et par les côtés de la poitrine plus distinctement traversés de bandes roussâtres.

Il faudrait voir des oiseaux adultes de cette localité pour se convaincre si les points de différence sont constants ou individuels.

400. SPEOTYTO CUNICULARIA (Mol.).

Pholeoptynx cunicularia Tacz. Orn. du Pérou, i. p. 144, pt.

Junin (Ingapirca): un mâle tué le 6 mai 1890. "Iris jaune."

Il paraît qu'il existe dans les environs de Junin une race locale de la *S. cunicularia* plus grande que toutes les autres formes de *Speotyto* connues. En cas que la différence dans la taille entre cette forme et la *S. cunicularia* typique du Chili serait constante nous lui réservons la dénomination de *S. cunicularia juninensis* Berl. & Stolzm.

♂ ♂. Al. 200-193,	caud. 100-93,	culm. 22 21,	tars. 43-41 mm.
♀. „ 213,	„ 110,	„ 23,	„ 50 „

En tout cas les oiseaux de Lima sont toujours beaucoup plus petits, à couleur généralement plus claire, moins roussâtre, et à tarse moins emplumé que les individus de Junin.

401. STRIX FLAMMEA PERLATA (Licht.).

Un mâle de Garita del Sol du 6 avril 1893. "Iris noir, bec blanchâtre, pattes d'un corné grisâtre tachetées de brun."

Fam. CATHARTIDÆ.

402. CATHARTES AURA PERNIGER (Sharpe).

Ingapirca, mai 1890.

Fam. FALCONIDÆ.

403. PHALCOBÆNUS MEGALOPTERUS (Meyen).

Baños (avril), San Blas (avril), Ingapirca (mai) et Andores (mai 1890): quatre individus. "Iris brun-marron, cire et visage rouge jaunâtres, pattes d'un jaune orangé. Chez le jeune les pattes sont d'un olive bleuâtre."

404. IBYCTER AMERICANUS (Bodd.).

Chanchamayo: un mâle du 5 juin 1891. "Iris rouge-cerise; bec jaune olivâtre; cire et mandibule inférieure à la base d'un plombé bleuâtre; joues et gorge pourprées; pattes d'un orangé rougeâtre."

405. CIRCUS CINEREUS (Vieill.).

Ingapirca: deux paires de mai et juin 1890. "Iris jaune, pattes jaunes, cire jaune avec une teinte verdâtre."

406. ACCIPITER PILEATUS (Temm.).

La Merced: un oiseau du 10 mars 1891.

407. BUTEO PENNSYLVANICUS (Wils.).

Maraynioc: une paire de novembre 1890.

408. BUTEO ERYTHRONOTUS (King).

Ingapirca: sept individus de mai et juin 1890. Maraynioc: une femelle du 17 septembre 1892. "Iris brun clair, pattes jaunes, cire jaune verdâtre."

409. BUTEOLA BRACHYURA (Vieill.).

La Merced: un jeune mâle du 26 août 1890. "Iris brun-café, bec noir, cire jaune verdâtre; pattes d'un jaune-citron."

410. BUTEOLA LEUCORRHOA (Quoy et Gaim.).

Tambo de Aza: une femelle du 16 novembre 1893. "Iris jaune orangé, bec noir, cire jaune verdâtre, pattes d'un jaune sale."

411. RUPORNIS NATTERERI (Scl. et Salv.).

La Merced: une paire de juillet et août 1890. "Iris jaune, cire jaune orangé; parties nues autour de l'œil jaune orangé; pattes jaune pale."

412. RUPORNIS MAGNIROSTRIS (Gml.).

Borgaña: une femelle du 30 avril 1891.

413. GERANOAËTUS MELANOLEUCUS (Vieill.).

Un mâle adulte de Maraynioc du 30 août 1892.

414. Ictinia plumbea (Gm.).

La Merced: un mâle du 31 août 1890. "Iris rouge-cerise, bec noir, pattes d'un carné rosâtre."

415. Regerhinus megarhynchus Des Murs.

Garita del Sol: une femelle du 15 août 1891.

416. Harpagus bidentatus (Lath.).

Borgoña: une femelle du 11 juin 1891.

417. Tinnunculus sparverius cinnamominus (Sw.).

Palcamayo: un mâle de juillet 1890.

418. Hypotriorchis fuscocærulescens (Vieill.).

Ingapirca: trois individus de juin 1890. Pariayacu: une femelle du 12 janvier 1893. "Iris brun foncé; cire, tour de l'œil et pattes jaunes."

Fam. Columbidæ.

419. Columba speciosa (Gm.).

La Merced: trois mâles du 22 août 1890, du février et avril 1891. "Iris brun foncé, bec rouge avec le bout blanc, pattes couleur framboise sale."

420. Columba albilinea Bp.

Columba albilineata Tacz. Orn. du Pérou, iii. p. 322.

Maraynioc: deux mâles de juillet et août 1892 et une femelle du 15 décembre 1891. "Iris: anneau extérieur d'un rosé pâle, intérieur mince argenté; bec d'un orangé olivâtre à pointe brune, pattes jaunes."

421. Columba rufina Temm. et Knip.

La Merced: une paire du 22 août 1890. "Iris couleur de rose, pattes couleur framboise."

422. Columba plumbea bogotensis Berl. et Lev.

Chlorœnas plumbea Vieill., subsp. n. *bogotensis* Berl. et Lev. Ornis, 1890, p. 32.
Columba vinacea (partim) Tacz. Orn. du Pérou, iii. p. 235.
Columba plumbea id. ibid. p. 234.

La Gloria: trois mâles adultes d'août 1890 et du 21 février 1891. "Iris jaune rougeâtre, tour de l'œil brun bleuâtre avec de petites taches d'un rouge sale; pattes couleur framboise."

Un œuf a été trouvé par M. Kalinowski à Chanchamayo. La forme de cet œuf est elliptique, la coque d'un blanc tirant un peu sur le jaunâtre. Lustre nul. Dimensions: 34 × 26·25 mm.

Les échantillons de la Gloria ne diffèrent des oiseaux de la Colombie (*C. p. bogotensis* Berl. et Lev.) que par la nuance du dessus et du dessous du corps plus claire, la gorge et la poitrine d'un rouge vineux plus grisâtre et par la queue plus longue. En

cas que ces différences seraient constantes on pourraît séparer ces échantillons comme *C. p. delicata.*

423. Gymnopelia anais (Less.).

Columba erythrothorax Meyen (1833) nec Temm. (1808–11).
Gymnopelia erythrothorax Tacz. Orn. du Pérou, iii. p. 249.

Tarma: une paire du 24 septembre 1890. Hacienda Queta: un mâle et deux femelles de décembre 1892 et d'août 1893. "Iris bleu, tour de l'œil jaune orangé, pattes carnées."

424. Columbigallina talpacoti (Temm.).

La Merced: trois mâles et deux femelles de juillet et septembre 1890, et mâle et femelle de février et avril 1891. "Iris rouge rosâtre, pattes d'un carné rosâtre."

Nous avons reçu un œuf de ce pigeon de Chanchamayo. Dimensions: 21·25 × 15·75 mm.

425. Metriopelia melanoptera (Mol.).

Tarma, Hacienda da Queta: deux mâles et une femelle de décembre 1892 et du 25 juillet 1893.

426. Leptoptila rufaxilla (Rich. et Bern.).

La Merced et La Gloria: mâle et femelle d'août 1890. "Iris jaune olivâtre."

427. Leptoptila ochroptera Pelz.

La Merced, Chanchamayo: deux mâles de juillet 1890. "Iris jaune rosâtre, tour de l'œil brun bleuâtre avec de petites taches d'un rouge sale, pattes d'un rouge framboise."

Comparés avec un individu du Musée Berlepsch provenant de la province de Rio Janeiro (*L. ochroptera* typique), ces oiseaux ne diffèrent que par le bec un peu plus long, par le brun du dos et des ailes un peu plus clair, par l'éclat améthyste du cou postérieur moins vif, le front un peu plus blanchâtre, la couleur cannelle du dessous de l'aile un peu plus claire. Il serait difficile de les séparer comme sous-espèce.

428. Geotrygon montana (Linn.).

Un individu pris vivant à Tarma au mois d'avril 1893.

429. Geotrygon frenata (Tsch.).

Deux femelles de La Merced et de La Gloria, Chanchamayo, août 1900 et 3 février 1891.

Fam. Penelopidæ.

430. Penelope boliviana Reichb.

La Gloria: un mâle du 7 août 1890. "Iris brun foncé, sac gulaire d'un rouge ochreux, pattes d'un rouge sale."

Chanchamayo: une femelle du 5 mai 1891.

431. Penelope sclateri plumosa, subsp. nov.

Penelope sclateri Ogilvie Grant, Cat. Birds Brit. Mus. xxii. p. 443 partim (Huasampilla); Tacz. Orn. du Pérou, iii. p. 269.

P. *quoad colorem* P. sclateri *dictæ ex Bolivia maxime affinis, sed gula superiore et tarsis dimidio basali ut in* P. montagnii *dicta plumosis, necnon plumis pectoris ventrisque superioris magis conspicue argenteo-albo marginatis distinguenda, alis caudaque quoque brevioribus.*

Al. 218, caud. 230, culm. 23, tars. 53 mm.

Hab. in Peruvia centrali or.: Maraynioc.

Typi in Mus. Branicki et Mus. Berlepschi.

Maraynioc, Pariayacu: un mâle et trois femelles de juillet 1892.

C'est un fait curieux que les oiseaux péruviens du Pérou central (Maraynioc, *coll. Kalinowski*) et du Pérou du sud (Paucarbambo, *coll. O. Garlepp*) ont le haut de la gorge et la moitié basale du tarse emplumé comme chez la *P. montagnii* de la Colombie et du Vénézuela, tandis que dans la coloration général ils ressemblent plutôt à la *P. sclateri* de la Bolivie. Ils diffèrent aussi des oiseaux boliviens par les plumes de la poitrine et de l'abdomen supérieur plus distinctement bordées de blanchâtre sur un fond plus noirâtre, caractère qu'ils ont aussi en commun avec la *P. montagnii*. Néanmoins ils présentent des bordures blanchâtres très prononcées aux plumes du dessus de la tête, du cou postérieur, du haut du dos et des tectrices susalaires comme chez la *P. sclateri*, bordures qui manquent chez la *P. montagnii*. Le bec est noirâtre comme chez la *P. sclateri* et non jaune rougeâtre comme chez la *P. montagnii*.

Chez la *P. sclateri* de la Bolivie il n'y a que des poils noirâtres sur la gorge, qui deviennent plus larges et plus abondants au menton. C'est pourquoi la gorge paraît presque tout-à-fait nue.

Chez la *P. montagnii* et chez la *P. s. plumosa* tout le haut de la gorge (sur une étendue d'à peu près 45 mm.) est couvert de plumes d'un gris argenté à tiges noires. Chez la dernière le tarse est emplumé du genou jusqu'à peu près la moitié de sa longueur, tandis que chez la *P. sclateri* ce n'est que le tiers basal qui est couvert de plumes.

432. Ortalis guttata adspersa (Tsch.).

Ortalida guttata Tacz. Orn. du Pérou, iii. p. 278 partim.

La Merced: une mâle du 13 septembre 1890. "Iris brun foncé, joues brunes, le menton rouge sale tirant sur le jaune, pattes d'un rouge framboise."

Garita del Sol: un mâle adulte du 3 août 1891.

Comparés avec un mâle adulte de Samiria, Amazone supérieur (coll. Hauxwell), du Musée Berlepsch, les échantillons du Pérou central et de la Bolivie paraissent différents par la tête en dessus d'un brun plus grisâtre, moins noirâtre, par les plumes du front bordées d'un blanc grisâtre (ce qui n'est pas le cas chez l'oiseau

de Samiria) et par les plumes du cou inférieur, de la poitrine et des côtés du cou plus distinctement terminées de blanchâtre, enfin par le dos d'un brun plus verdâtre.

Par les bordures blanchâtres du front cette forme paraît se rapprocher de l'*O. caracco* Wagl. de la Colombie, espèce que nous ne connaissons pas.

433. CHAMÆPETES RUFIVENTRIS (Tsch.).

Garita del Sol: deux mâles adultes du juin 1891.

434. ABURRIA ABURRI (Less.).

Garita del Sol: un mâle adulte du 4 août 1891.

Ils paraît que les oiseaux péruviens (♂ ad. de Tambillo et deux ♀ adultes de Cuzco, *coll. O. Garlepp*) ont les dimensions plus petites qu'un oiseau de l'Ecuadeur oriental. En outre ils présentent l'éclat métallique plus verdâtre au dos et au bas du cou.

Fam. PHASIANIDÆ.

435. ODONTOPHORUS SPECIOSUS Tsch.

Garita del Sol: deux mâles adultes du juin et juillet 1891. "Iris brun de café, bec noir, pattes d'un plombé bleuâtre."

Fam. TINAMIDÆ.

436. TINAMUS TAO Temm.

Tinamus kleei (Tsch.) Tacz. Orn. du Pérou, iii. p. 293.

La Gloria: un mâle du 8 août 1890 et une femelle du 8 février 1891. "Iris brun foncé, mandibule supérieure noire, l'inférieure couleur de rose brunâtre; pattes d'un plombé bleuâtre."

437. CRYPTURUS OBSOLETUS (Temm.).

La Gloria: deux mâles du 3 février 1891. La Garita del Sol: un mâle du 20 août 1891. "Iris jaune brunâtre, bec noir à mandibule inférieure plus pâle, pattes olivâtres."

438. CRYPTURUS TATAUPA Temm.

La Merced: trois individus de juillet et août 1890 et une femelle du 23 mai 1891. "Iris chez le mâle rouge, chez la femelle rouge sale, bec rouge clair; pattes couleur framboise sale, ongles jaunes."

Al. 131–127½, caud. 47½–45, culm. 24¼–23½, tars. 33–32½ mm.

Ces oiseaux paraissent identiques à un individu de Tucuman (recueilli par Borelli), néanmoins ils ont le dos et les tectrices susalaires d'un brun plus rougeâtre et plus intense, le bec d'un jaune uniforme sans pointe noirâtre et le piléum d'un noirâtre plus intense. Le type de Temminck venait du Brésil méridional. Peut-être les oiseaux de Brésil ont-ils le bec plus court.

439. Nothoprocta branickii Tacz.

Baños: un mâle du 29 avril 1890 comparé avec le type du Muséum de Varsovie. "Iris brun rougeâtre."

Tarma, Hacienda da Queta: un mâle du 8 juillet 1893.

440. Nothoprocta taczanowskii Scl. et Salv.

Maraynioc, Pariayacu: deux mâles du 29 novembre 1891 et du 1 août 1892. "Iris rouge-brique pâle, bec brun, pattes d'un jaune pâle."

Fam. Phalacrocoracidæ.

441. Phalacrocorax vigua (Vieill.).

Ingapirca: une jeune femelle de juin 1890. "Iris vert, bec carné grisâtre avec la ligne médiane noirâtre, la mandibule inférieure à la base jaune."

La Merced: une femelle du 14 janvier 1891.

Fam. Ibididæ.

442. Plegadis ridgwayi (Allen).

Baños et Ingapirca: trois individus d'avril et mai 1890. "Iris rouge, bec brun rougeâtre, pattes noires. Iris chez le jeune brun."

♂ semiad.	Al. 296,	caud. 127,	culm. 123½,	tars. 86½	mm.
♂ juv.	„ 284½,	„ 111,	„ 80½,	„ 79	„
♀ juv.	„ 257,	„ 104,	„ 70½,	„ 66	„

443. Theristicus branickii Berl. et Stolzm.

Theristicus branickii Berl. et Stolzm. Ibis, 1894, p. 404 (descr. orig.); Salvad. Ibis, 1900, pp. 501 517, pls. ix., x.

Theristicus caudatus Tacz. (nec Bodd.) Orn. du Pérou, iii. p. 417, part.

Maraynioc, Pariayacu: deux mâles adultes et une femelle adulte recueillis le 22 décembre 1891 et le 13 octobre 1892. "Iris d'un rouge sale, bec brun, d'un plombé verdâtre à l'extrémité; les parties nues d'un brun noirâtre; pattes rouges."

Fam. Ardeidæ.

444. Leucophoyx candidissima (Gm.).

Ingapirca: une femelle du 9 mai 1890. "Iris jaune, bec noir avec la base jusqu'aux yeux jaune orangé; pattes d'un olive jaunâtre avec les doigts et le talon d'un jaune olivâtre."

445. Herodias egretta (Gm.).

Ingapirca: un mâle de juin 1890. "Iris jaune, bec jaune-orange, pattes noires."

446. Nycticorax nycticorax obscurus (Bp.).

Ingapirca: trois individus de mai et juin 1890. "Iris rouge,

bec noir avec la mandibule inférieure en dessous jaune verdâtre ; pattes jaunes lavées de verdâtre, doigts brunâtres."

La Merced : une paire d'oiseaux jeunes de mars 1891. Jauja : un oiseau jeune du 19 juillet 1893.

Les œufs sont d'un vert bleuâtre pâle. La forme varie beaucoup même dans la même ponte. Il y a des œufs ovoïdes, courts et assez bombés, d'autres sont oblongs et presque élliptiques. Il y en a un qui a la forme d'une poire allongée.

Les dimensions par pontes :—

1°.	2°.	3°.
50·50 × 37·50	55 × 37·50	57·50 × 38·50
50 × 39·25	56·25 × 36	56·25 × 39 mm.
(carré)	(avorton)	

447. TIGRISOMA SALMONI Scl. et Salv.

La Merced : un mâle adulte du 27 mars 1891. "Iris jaune olive brunâtre ; bec noir corné, les sourcils, une mince raie devant l'œil et parties nues sur la mandibule inférieure d'un jaune olivâtre. Mandibule inférieure à la base et en dessous d'un bleu clair ; pattes d'un plombé brunâtre en avant, d'un gris verdâtre en arrière.

Fam. RALLIDÆ.

448. RALLUS RYTHIRHYNCHUS Vieill.

Ingapirca : mai et juin 1890.

449. RALLUS NIGRICANS HUMILIS, subsp. nov.

Rallus nigricans Tacz. Orn. du Pérou, iii. p. 317.

R. R. nigricans *dicto simillimus, sed minor, rostro imprimus multo breviore et graciliore ; pileo anteriore clariore plumbeo, corpore superiore reliquo occipiteque pallidius olivaceo-brunneis (nec oleagineo-brunneis), gula albescentiore, necnon tectricibus subalaribus intensius nigris (nec brunneo-nigris) apice albescente marginatis, distinguendus.*

♀. Al. 126, caud. 57, culm. 43½, tars. 40½ mm.

Hab. in Peruvia centrali orientali : Chanchamayo.

Typus in Mus. Branicki. ♀ La Merced, Chanchamayo (J. Kalinowski, legit no. 1123).

La Merced : une femelle du 30 janvier 1891. "Iris rouge, bec vert teinté de jaune à la base, pattes d'un rouge sale pâle."

Comparé à deux oiseaux de Sta. Catharina et un autre d'Antioquia, la femelle de La Merced présente des dimensions beaucoup plus petites, surtout le bec plus court et plus effilé ; la partie antérieure du piléum d'un gris plombé plus pur et plus bleuâtre, les côtés de la tête également d'un plombé plus bleuâtre, la gorge plus blanchâtre ; les parties supérieures du corps jusqu'à l'occiput d'un brun-olive plus clair ou moins oléagineux ; enfin les tectrices sousalaires d'un noirâtre plus intense (moins brunâtre) et bordées à la pointe de blanchâtre.

450. Aramides cayanea chiricote (Vieill.).

Aramides cayannensis (Gml.), Tacz. Orn. du Pérou, iii. p. 318.

La Merced : une femelle du 19 juillet 1890. "Iris rouge, bec d'un jaune olivâtre pâle avec le bout bleu de ciel, tour de l'œil rouge ; pattes d'un rouge sale."

451. Creciscus viridis subrufescens Berl. et Stolzm., subsp. nov.

[*Rallus viridis* Müll. 1776.]
[*Rallus cayanensis* Bodd. 1783.]
Porzana cayennensis Tacz. Orn. du Pérou, iii. p. 323.

C. C. viridis *dicto ex Cayenne affinis, differt corpore subtus pallide fulvescenti-rufo nec castaneo, gula fere albescente, pileo pallidiore rufo, necnon corpore superiore clariore griseo-olivaceo (nec brunnescenti-olivaceo), tectricibus subalaribus pallide rufescentibus nec rufo-brunneis.*

		Al.	Caud.	Culm.	Tars.
La Merced.	♂♂.	87–86	31	17¼	35½ mm.
,,	♀.	90	37		36 ,,
Huayabamba.	Adult.	91	32½	19	36½ ,,

Hab. in Peruvia orientali (septentrionali et centrali).

Typus in Mus. Branicki : ♂. La Merced, Chanchamayo.

La Merced : trois individus d'août 1890.

Les oiseaux de La Merced (Mus. Branicki) et de Huayabamba (coll. Garlepp—Mus. Berlepsch) se distinguent des échantillons de Cayenne par les parties inférieures du corps d'un roux beaucoup plus pâle, par la gorge presque blanchâtre au lieu de roussâtre, le milieu du ventre plus pâle (blanchâtre chez les oiseaux de La Merced), par le roux du piléum plus clair et moins intense, enfin par les parties supérieures du corps d'un olive plus clair, plus grisâtre au lieu de brunâtre. Les échantillons des collections de Bogotá (Musée Berlepsch) s'accordent en général avec les péruviens, mais ils semblent avoir les côtés de la tête d'un gris plus roussâtre et les parties supérieures du corps d'un brun roussâtre ou d'un olive roussâtre au lieu d'un olive grisâtre.

Les oiseaux de Bahia (Musée Berlepsch) présentent les parties inférieures du corps et le piléum d'un roux châtain encore plus intense que les oiseaux de Cayenne. Peut-être qu'on pourrait les séparer sous la dénomination de *P. viridis pileata* (Wied).

D'après les remarques du docteur Sharpe (Cat. Birds, xxiii. p. 145) il paraît que *Crex facialis* Tschudi serait un jeune du *C. viridis subrufescens*, mais il est impossible d'en juger d'après la description de M. Tschudi.

452. Creciscus melanophæus (Vieill.).

La Merced : un mâle du 26 août 1890. "Iris brun bleuâtre, bec noir avec les côtés et la base verts, un peu jaunâtres ; pattes olives."

Al. 85, caud. 45, culm. 19¼, tars. 32½ mm.

Cet individu se distingue des échantillons de Bahia du Musée Berlepsch par les ailes et la queue plus longues, par les parties supérieures du corps d'un brun-olive plus verdâtre, par le front mêlé de plumes d'un brun roussâtre et par la présence d'une strie roussâtre au-dessus des freins qui est d'un blanc sâle chez les oiseaux de Bahia. L'espace derrière l'œil est également d'un brun roussâtre au lieu d'un brun-olive concolore au dos. Le croupion est d'un brun noirâtre plus foncé et les rectrices sont d'un noirâtre plus intense. Pour vérifier ces différences il faudrait plusieurs individus du Pérou pour comparer. Peut-être que l'oiseau péruvien fait le passage du *C. melanophæus* au *C. œnops* (Scl. et Salv.) de l'Ecuador oriental.

Espèce nouvelle pour la faune péruvienne.

453. FULICA ARDESIACA Tsch.

Ingapirca: trois mâles de mai 1890. "Iris rouge, bec avec la scutelle frontale d'un blanc un peu plombé; pattes d'un plombé pâle."

Les œufs au nombre de 11 de Junin ressemblent absolument par la forme et la coloration aux œufs de la Foulque d'Europe (*Fulica atra*). Ils sont seulement plus grands.

Dimensions:—

63·50 × 41; 65 × 38; 60·25 × 39·50; 61 × 38; 64 × 38; 61·25 × 40; 59·25 × 39·50; 59·50 × 40; 60·75 × 39·50; 61 × 41; 62 × 40 mm.

454. FULICA GIGANTEA Eyd. et Soul.

Ingapirca: une femelle du 10 mai 1890. "Iris brun clair, bec brun rougeâtre avec le bout même jaune olivâtre, scutelle frontale au milieu blanc olivâtre, sur les côtés jaune, pattes d'un brun rougeâtre avec une teinte olivâtre."

455. GALLINULA GALEATA (Licht.).

Ingapirca: deux paires de mai et juin 1890. "Iris brun cendré, bec et scutelle frontale rouges, le quatre terminal du bec jaune verdâtre, anneau sur les tibias d'un rouge cinnabre."

Fam. EURYPYGIDÆ.

456. EURYPYGA MAJOR MERIDIONALIS, subsp. nov.

E. E. major *dictæ ex America centrali maxime affinis, differt fasciis dorsi superioris nigris multo angustioribus et minus clare definitis, collo superiore dorsoque magis conspicue rufescente radiatis vel irroratis, necnon ventre medio purius albo, minus fulvo tincto.*

♂. Al. 237,	caud. 161,	culm. 61,	tars. 53½ mm.
♀. „ 215,	„ 144,	„ 55½,	„ 56½ „

Hab. in Peruvia centrali; La Merced, Chanchamayo.

Typus in Mus. Branicki: ♂. La Merced le 23 mars 1891, no. 1195.

La Merced : une paire des 23 et 28 mars 1891. "♂. Iris rouge de sang, bec brun en dessus, le bord de la mandibule supérieure et toute la mandibule inférieure d'un orangé ochreux. ♀. Iris d'un rouge orangé, mandibule inférieure orangé olivâtre; pattes d'un jaune brunâtre."

Les échantillons de Chanchamayo ont la même taille que les oiseaux de Bogotá et de Costa Rica (*E. major* Hartl.). Ils diffèrent néanmoins par les bandes noirâtres du dos supérieur beaucoup plus étroites et par le dos supérieur et la nuque plus distinctement rayés d'un roux roussâtre, plus clair que chez la *P. major* typique. Le milieu du ventre paraît plus blanchâtre, moins roussâtre.

Enfin chez les oiseaux péruviens il y a une bande d'un roux châtain sur la première rémige qui manque chez l'oiseau de Costa Rica, tandis qu'il y en a deux chez un oiseau de Bogotá du Musée Berlepsch.

Order GRALLÆ.

457. Oreophilus ruficollis (Wagl.).

Entre Tarma et Oroya : une femelle du 24 septembre 1890. "Iris noire, pattes rosés."

458. Ptiloscelis resplendens (Tsch.).

Ingapirca : deux paires de mai 1890. Maraynioc : une femelle du 6 juillet 1892. "Iris rouge-cerise ; bec à la base rouge rosâtre, le reste noir ; pattes d'un rouge carné."

459. Ægialitis collaris (Vieill.).

La Merced : trois individus de juillet et août 1890, "iris brun foncé" ; et une femelle et un oiseau sans indication de sexe du 31 janvier 1891.

460. Ægialitis alticola, sp. nov.

Ægialitis occidentalis Sharpe (nec Cab.), Cat. Birds Brit. Mus. vol. xxiv. (1896) p. 295 (Tarapacá).

Æ. Æ. falklandica *dictæ maxime affinis, sed minor, rostro imprimis debiliore et breviore, corpore subtus fere unicolore albo, nec fasciis duabus latis nigris instructo, pectoris lateribus solummodo fusco maculatis et fascia infra-pectorali interrupta e maculis fuscis vel rufescentibus composita prædito, corpore supra tectricibusque alarum superioribus pallidius griseo-brunneis, necnon fasciis indistinctis pilei medii nuchæque capitisque lateribus pallidius rufescentibus distinguenda*

♀ ♀. Al. $123\frac{1}{2}$–121, caud. 54–53, culm. $14\frac{3}{4}$, tars. $28\frac{1}{2}$–$25\frac{3}{4}$ mm.

Hab. in Peruvia alta.

Typus in Mus. Branicki: ♀. Ingapirca, J. Kalinowski, legit no. 518.

Ingapirca : deux femelles du 13 mai 1890. "Iris brun foncé, bec et pattes noirs."

Cette nouvelle *Ægialitis* paraît le plus voisine de l'*Æ. falklandica* (Lath.) d'Argentine et du Chili, dont elle ne diffère que par les dimensions plus petites surtout le bec plus petit et plus faible, et par le manque presque complet des deux larges bandes noires sous la gorge et à la poitrine inférieure. Ces bandes ne sont indiquées que par de petites taches noirâtres aux côtés extrêmes de la poitrine et par une sorte de bande très peu marquée, composée de petites taches noirâtres ou roussâtres tres pâles sur la poitrine inférieure. Les parties supérieures du corps et les tectrices sousalaires sont d'un gris-brun plus pâle et le roussâtre des bandes au piléum et à la nuque et des côtés de la tête est plus pâle. Enfin les tarses et les pieds sont d'un noir profond au lieu de brunâtres.

Berlepsch ayant examiné le type de l'*Æ. occidentalis* Cab. au Musée de Berlin, provenant du Chili, a pu se convaincre qu'il appartient à l'espèce plus petite à pieds jaunâtres, à grandes taches noires sur chaque côté de la poitrine et à bande noire céphalique très large, savoir l'*Æ. nivosa* Cass. ou à une sous-espèce très peu distincte qu'on pourraît nommer l'*Æ. nivosa occidentalis* Cab.

M. Sharpe, dans le Catalogue du Musée Britannique, n'a pas séparé les oiseaux chiliens de l'*Æ. nivosa* Cass.

D'autre part les oiseaux de Tarapacá à pieds noirs qu'il décrit sous la dénomination de l'*Æ. occidentalis* Cab. appartiennent probablement à notre *Æ. alticola*.

461. HIMANTOPUS MEXICANUS (P. L. S. Müll.).

Ingapirca : trois oiseaux de mai 1890. "Iris rouge, bec noir, pattes rouge rosâtres."

462. RECURVIROSTRA ANDINA Philippi et Landb.

Ingapirca : un mâle du 19 mai 1890. "Iris rouge, bec noir corné, pattes d'un plombé bleuâtre."

463. TOTANUS MELANOLEUCUS (Gm.).

Ingapirca : quatre femelles de mai 1890. "Iris brun foncé, pattes d'un jaune sale."

464. TOTANUS FLAVIPES (Gm.).

Ingapirca : deux femelles de mai. La Merced : de septembre 1890. "Iris brun foncé, pattes d'un jaune olivâtre."

465. HELODROMAS SOLITARIUS (Wils.).

La Merced : un mâle du 21 mars 1891.

466. TRINGOIDES MACULARIUS (Linn.).

La Merced : août et septembre 1890, et un mâle du 23 mars 1891. "Iris brun foncé."

467. HETEROPYGIA MACULATA (Vieill.).

Ingapirca : quatre individus de mai 1890. "Iris brun foncé,

bec à la base brun jaunâtre, vers le bout noir, pattes d'un jaune olivâtre."

468. Gallinago paraguaiæ (Vieill.).

La Merced: un mâle adulte du 21 mars 1891 (juillet?). "Iris brun foncé, bec olive grisâtre dans sa partie basale, noir dans la partie terminale; pattes d'un olive verdâtre."

Al. 125, caud. 52½, culm. 73½, tars. 35½ mm.

Cet oiseau ne diffère des oiseaux du Paraguay et de Rio Grande do Sul que par le bec, les tarses et les doigts un peu plus longues et par le plumage généralement plus blanchâtre. Les bordures des plumes du dos et des scapulaires sont plus blanchâtres, les maculatures du cou inférieur et de la poitrine plus brunâtres moins noirâtres, les souscaudales moins variées de maculatures noirâtres.

469. Gallinago andina (Tacz.).

Ingapirca: cinq individus de mai et juin 1890. "Iris brun foncé; bec brun foncé dans sa partie terminale, carné brunâtre à la basale; pattes jaunes."

470. Gallinago jamesoni (Bp.).

Maraynioc, Parrayacu et Maláo: un mâle adulte et une femelle adulte du 7 août 1892 et du 26 novembre 1891. "Iris brun noirâtre et brun foncé, bec brun carné, pattes d'un gris pâle."

♂. Al. 158½, caud. 52, culm. 90½, tars. 38½ mm.
♀. „ 160, „ 62, „ 91½, „ 40½ „

471. Steganopus tricolor (Vieill.).

Ingapirca: un jeune mâle en plumage de transition de mai 1890. "Iris brun foncé, bec noir, pattes d'un brun jaunâtre."

472. Thinocorus orbignyanus Geoffr. et Less.

Baños: trois individus d'avril et mai 1890. Hacienda Queta: un mâle du 19 juillet 1893. "Iris brun, bec à la base et pattes d'un jaune orangé."

Fam. Laridæ.

473. Larus serranus Tsch.

Ingapirca: trois individus de mai 1890. "Iris brun foncé, bec et pattes d'un brun rougeâtre, tour de l'œil rouge."

Fam. Phœnicopteridæ.

474. Phœnicopterus chilensis Mol.

Ph. ignipalliatus d'Orb. et Geoffr. St. Hil., Tacz. Orn. du Pérou, iii. p. 432.

Ingapirca: six oiseaux de mai et juin 1890. "Iris blanc jaunâtre; bec dans la moitié basale blanc rosâtre, dans la moitié

terminale noir; pattes d'un olive très clair, doigts avec la membrane et l'articulation tarso-tibienne d'un rouge rosâtre."

Les œufs sont d'un blanc jaunâtre. La forme est presque elliptique, quoique on voit un certain amincissement vers le petit bout. La coque est médiocrement rugueuse et âpre au toucher.

La granulation, quoique visible à l'œil nu, est comme émoussée; en général la coque possède un certain lustre. Les dimensions de la seule ponte envoyée par M. Kalinowski de Junin sont 76 × 52·50, 76 × 52 mm.

Fam. ANATIDÆ.

475. CHLOËPHAGA MELANOPTERA (Eyt.).

Bernicla melanoptera Tacz. Orn. du Pérou, iii. p. 467.

Ingapirca: deux paires de mai et juin 1890. "Iris noir, bec d'un rosé un peu bleuâtre, pattes rouges."

476. ANAS CRISTATA Gm.

Maraynioc: un mâle du 30 juin 1892. "Iris orangé, bec d'un bleu brunâtre, mandibule inférieure d'un ochracé rougeâtre. Pattes d'un brun grisâtre.

477. NETTION OXYPTERUM (Meyen).

Ingapirca: deux paires de mai et juin 1890. "Iris brun foncé; bec jaune avec la ligne médiane et le bout de la mandibule supérieure noirs; pattes d'un plombé brunâtre."

478. DAFILA SPINICAUDA (Vieill.).

Ingapirca: trois individus de mai 1890. "Iris brun foncé; les parties supérieures du bec noires, les côtés à la base jaunes, vers le bout bleu de ciel avec le bord noir; pattes d'un brun grisâtre."

479. QUERQUEDULA PUNA (Tsch.).

Ingapirca: quatre individus de mai 1890 "Iris brun rougeâtre."

Les œufs, au nombre de cinq, ont été trouvés par M. Kalinowski à Junin. Ils sont d'une forme ovale, assez allongés. La couleur est roussâtre pâle à peu près de la teinte des variétés foncées des œufs de la poule domestique. La grandeur est plus ou moins celle des œufs du canard sauvage (*Anas boschas*).

Dimensions: 56·50 × 38; 56 × 37·25; 57 × 37·50; 57·75 × 38·50; 57·25 × 38·25 mm.

480 ERISMATURA FERRUGINEA Eyton.

Ingapirca: une femelle du 27 mai 1890. "Iris brun foncé, bec et pattes d'un noir brunâtre."

481. MERGANETTA LEUCOGENYS (Tsch.).

Acobamba: une femelle du 11 juillet 1890. Maraynioc: une femelle du 14 novembre 1892. "Iris brun foncé, bec rouge de sang avec la partie supérieure noirâtre, pattes d'un rouge sale."

Fam. Podicepidæ.

482. Podiceps americanus Garnot.

P. rollandi Tacz. (nec Quoy et Gaim.) Orn. du Pérou, iii. p. 494.

Ingapirca: six individus de mai et juin 1890. "Iris d'un rouge vif avec un dessin noir; bec noir; pattes dans leur partie intérieure olives, extérieurement brunes. Chez le jeune le bec est d'un brun clair avec la mandibule inférieure brun jaunâtre; pattes d'un olive brunâtre."

Les oiseaux adultes sont un peu plus grands, à bec un peu plus long qu'un mâle adulte de Punta Arenas (Magellan) du Musée Berlepsch. Il paraît aussi que le mâle de Punta Arenas a le blanc plus répandu aux rémiges secondaires et aux barbes internes des primaires.

♂. Ingapirca	Al. $116\frac{1}{4}$,	culm. $23\frac{1}{2}$,	tars. 39	mm.
♀♀. "	" 114,	" $20-19\frac{1}{2}$,	" $37\frac{1}{2}-35$	"
♂ ad. Punta Arenas	" 112,	" $18\frac{1}{2}$,	" 36	"

Deux œufs de Junin sont fusiformes, c'est-à-dire très allongés et également et fortement attenués aux deux bouts. La couleur est blanche sale, suffusée en grande partie d'un roussâtre pâle qui provient d'une matière colorante étrangère. Dimensions: 49 × 29; 48 × 29·50 mm.

483. Podiceps taczanowskii Berl. et Stolzm.

Podiceps taczanowskii Berl. et Stolzm. Ibis, 1894, p. 109, pl. iv. (descr. orig.).

Podiceps caliparæus Tacz. (nec Less. et Garn.) Orn. du Pérou, iii. p. 493 partim.

Ingapirca (lacus Junin): trois paires de mai 1890. Maraynioc: un mâle du 11 juillet 1892. "Iris rouge clair, bec gris clair, pattes d'un olivâtre plombé dans leur partie intérieure et d'un gris brunâtre extérieurement."

Deux œufs ont été obtenus à Junin par M. Kalinowski. Ils ont la forme des œufs des Plongeons en général, seulement ils sont un peu moins oblongs. La coque est blanche sale colorée ça et là par une matière étrangère d'un rosâtre pâle. Dimensions: 47 × 33, 75·47 × 33·50 mm.

Notes relatives à la première partie de cet article.

No. 9. *Myiadestes leucotis* (Tsch.), P.Z.S. 1896, p. 327, serait *Entomodestes leucotis* (Tsch.) (gen. *Entomodestes* Stejn. Pr. U.S. Nat. Mus. v. p. 456 note).

No. 14. *Troglodytes frater* Sharpe, l. c. p. 328, serait *Troglodytes solstitialis macrourus* Berl. et Stolzm., subsp. nov :—

T. *a* T. solstitialis *dicto cauda multo longiore et stria superciliari pallidiore a* T. frater *dicto, cui longitudine caudæ æmulat, stria superciliaris pallide rufescenti nec albo, gula cum pectore*

lateribusque colli lætius rufescentibus necnon abdomine magis albo distinguendus.

♂ ♂ ad. Al. 53¾–52, caud. 40½–39½, culm. 13½–13¼, tars. 19½–18¾ mm.

Hab. in Peruvia centrali.

Typus in Mus. Branicki.

Cette forme nouvelle paraît justement intermédiaire entre le *T. solstitialis* de la Colombie et le *T. frater* Sharpe de la Bolivie. Elle a la queue aussi longue que le *T. frater*, c'est-à-dire beaucoup plus longue que le *T. solstitialis*. Elle diffère néanmoins du *T. frater*, ayant la strie sourcilière d'un roussâtre pâle, un peu plus pâle que chez le *T. solstitialis* au lieu d'être d'un blanc pur comme chez le *T. frater*. Elle diffère des deux formes connues par le milieu de l'abdomen d'un blanc ne contrastant pas visiblement avec la couleur roussâtre de la gorge et du haut de la poitrine, tandis que chez le *T. solstitialis* et le *T. frater* le blanc de l'abdomen est plus ou moins lavé de roussâtre. Le *T. frater* a généralement la gorge d'un roussâtre plus pâle et les parties supérieures du corps d'un brun plus foncé, moins roussâtre.

No. 54. *Arbelorhina cærulea microrhyncha* (Berl.) l. c. p. 337, serait *Cyanerpes cærulea microrhynchus* (Berl.) (gen. *Cyanerpes* Oberh. Auk, 1899, p. 32).

No. 59. *Chlorophonia torrejoni* Tacz. l. c. p. 338, serait probablement la même que *Chl. longipennis* (Du Bus).

No. 66. *Calliste chilensis* (Vig.) l. c. p. 339, serait *Calospiza chilensis* (Vig.) (le genre *Calliste* est préoccupé par *Calospiza*).

No. 67. *Calliste schranki* (Spix) l. c. p. 339, serait *Calospiza schranki* (Spix).

No. 68. *Calliste xanthogastra rostrata* Berl. et Stolzm. l. c. p. 339, serait *Calospiza xanthogastra rostrata* (Berl. et Stolzm.).

No. 69. *Calliste punctulata* Scl. et Salv. l. c. p. 340, serait *Calospiza punctulata* (Scl. et Salv.).

No. 70. *Calliste pulchra* (Tsch.) l. c. p. 340, serait *Calospiza pulchra* (Tsch.).

No. 71. *Calliste gyroloides* (Lafr.) l. c. p. 340, serait *Calospiza gyroloides* (Lafr.).

No. 72. *Calliste fulvicervix* Scl. et Salv. l. c. p. 340, serait *Calospiza fulvicervix* (Scl. et Salv.).

No. 73. *Calliste argentea* (Tsch.) l. c. p. 340, serait *Calospiza argentea* (Tsch.).

No. 74. *Calliste boliviana* (Bp.) l. c. p. 340, serait *Calospiza boliviana* (Bp.).

No. 75. *Calliste nigricincta* (Bp.) l. c. p. 341, serait *Calospiza nigricincta* (Bp.).

No. 76. *Calliste nigriviridis berlepschi* (Tacz.) l. c. p. 341, serait *Calospiza nigriviridis berlepschi* (Tacz.).

No. 77. *Calliste cyanicollis* (Lafr. et d'Orb.) l. c. p. 341, serait *Calospiza cyanicollis* (Lafr. et d'Orb.).

No. 78. *Calliste parzudakii* (Lafr.) l. c. p. 341, serait *Calospiza parzudakii* (Lafr.).

No. 79. *Calliste melanotis* Scl. l. c. p. 341, serait *Calospiza melanotis* (Scl.).

No. 80. *Calliste xanthocephala* (Tsch.) l. c. p. 341, serait *Calospiza xanthocephala* (Tsch.).

No. 133. *Pseudochloris lutea* (Lafr. et d'Orb.) l. c. p. 351, serait *Pseudochloris chloris* (Tsch.) subsp.

No. 138. *Ammodromus peruanus* (Bp.) l. c. p. 353, serait *Myiospiza peruana* (Bp.) (gen. *Myiospiza* Ridgw. Auk, 1898, p. 224).

No. 156. *Ochthœca jelskii spodionota* Berl. et Stolzm. l. c. p. 356, serait *Ochthœca pulchella* Scl. et Salv.

Berlepsch ayant examiné le type de l'*O. pulchella* Scl. et Salv. au Musée Britannique a pu constater que c'est un jeune oiseau qui ne présente qu'une bordure jaune très étroite au front, qui néanmoins est présente, mais dont Messrs. Sclater et Salvin n'ont pas fait mention en décrivant cette espèce.

En attendant Berlepsch a reçu quatre oiseaux adultes recueillis par M. O. Garlepp dans les Yungas occidentales de la Bolivie et après les avoir comparés avec les échantillons du Pérou central a trouvé qu'ils ne diffèrent dans aucun détail. Ils faudra donc réunir l'*O. jelskii spodionota* au *O. pulchella*. L'*O. jelskii* du Pérou du nord occidental diffère dans quelques détails de coloration et pourraît être distingué comme *O. pulchella jelskii* (Tacz.).

No. 206. *Myiobius fulvigularis* Salv. et Godm. l. c. p. 366, serait mieux nommé *M. erythrurus fulvigularis* (Scl. et Salv.).

No. 279. *Pyriglena maura picea* (Cab.) l. c. p. 383. La différence indiquée relativement aux dimensions de la *P. maura* et de la *T. picea* n'est pas constante.

Conclusions.

M. Kalinowski a donc rapporté des environs de Junin, de la vallée de Chanchamayo et de celle de Vitoc (les deux situées dans le département de Junin) des individus représentant 483 espèces d'oiseaux.

Pour compléter la liste des espèces d'oiseaux qui se trouvent dans ces contrées nous ajoutons une spécification des espèces, qui y ont été trouvées par feu Constantin Jelski et d'autres voyageurs, mais qui ont échappé aux recherches de M. Kalinowski.

1. *Catharus fuscater* (Lafr.).—Chilpes (Jelski).
2. *Turdus crotoperus* Licht.—Amable-Maria (Jelski) (peut-être = *T. phæopygus spodiolæmus* Berl. et Stolzm. ?).

3. *Turdus leucops* Tacz.—Ropaybamba (Jelski).
4. *Microcerculus bicolor* Des Murs.—Amable-Maria (Jelski).
5. *Basileuterus tristriatus* (Tsch.).—Auquimarca, Ropaybamba (Jelski).
6. *Diglossa sittoides* (Lafr. et d'Orb.).—Auquimarca, Pumamarca (Jelski).
7. *Hylophilus ferrugineifrons* Scl.—Amable-Maria (Jelski).
8. *Creurgops verticalis* Scl.—Ropaybamba (Jelski).
9. *Trichothraupis melanops* (Vieill.).—Amable-Maria, Ropaybamba, Pumamarca (Jelski).
   T. quadricolor (Vieill.).
10. *Nemosia pectoralis* Tacz.—Acancocha (Jelski).
11. *Chlorospingus ignobilis* Scl.—Pumamarca (Jelski).
12. „ *berlepschi* Tacz.—Ropaybamba (Jelski).
13. *Microspingus trifasciatus* Tacz.—Maraynioc (Jelski).
14. "*Buarremon*" *mystacalis* Tacz.—Ninarupa (Jelski).
15. *Ochthodiæta signata* Tacz.—Auquimarca, Ninabamba (Jelski).
16. *Cnipolegus anthracinus* Cab.—Huanta, Higos (Jelski).
17. *Muscisaxicola grisea* Tacz.—Maraynioc (Jelski).
18. *Capsiempis orbitalis* Cab. Amable-Maria (Jelski).
19. *Pogonotriccus ophthalmicus* Tacz.—Amable-Maria, Ropaybamba (Jelski).
20. *Tyranniscus nigricapillus* (Lafr.).—Pumamarca (Jelski).
21. „ *cinereiceps* Scl.—Ropaybamba (Jelski).
22. „ *viridiflavus* (Tsch.).—? Paltaypampa, Amable-Maria (Jelski).
23. *Rhynchocyclus fulvipectus* Scl.—Ropaybamba (Jelski).
24. „ *peruvianus* Tacz. „ „
25. *Myiobius villosus* Scl.—Amable-Maria (Jelski).
26. „ *superciliaris* Tacz.—Ropaybamba (Jelski).
27. *Pachyrhamphus viridis* (Vieill.).—Amable-Maria (Jelski).
28. *Doliornis sclateri* Tacz.—Maraynioc (Jelski).
29. *Upucerthia pallida* Tacz.—Junin (coll. Raimondi).
30. *Cinclodes palliatus* (Tsch.).—Vitoc (Tschudi), Ninarupa (Jelski).
31. *Leptasthenura andecola* Scl. et Salv.—Ninarupa (Jelski).
32. *Synallaxis curtata* Scl.—San Bartolomé (Jelski).
33. *Siptornis virgata* (Tacz.).—Junin (Jelski).
34. *Automolus striaticeps* Tacz.—Chilpes (Jelski).
35. „ *ochrolæmus* (Tsch.).—Amable-Maria (Jelski).
36. *Philydor montanus* (Tsch.).—Maraynioc (Jelski).
37. *Anabazenops rufosuperciliatus cabanisi* Tacz.—Pumamarca (Jelski).
38. *Dysithamnus ardesiacus* Scl. et Salv.—Amable-Maria (Jelski).
39. *Myrmotherula atrogularis* Tacz.—Amable-Maria (Jelski).
40. „ *menetriesi* d'Orb.—Amable-Maria (Jelski).
41. *Terenura callinota* Scl.—Ropaybamba (Jelski).
42. *Myrmeciza hemimelæna* Scl.—Amable-Maria (Jelski).
43. *Pithys albifrons peruviana* Tacz.—Amable-Maria (Jelski).

44. *Talaphorus hypostictus* (Gld.).—Soriano (Jelski).
45. *Iolæma schreibersi* (Bourc.).—C. Pérou (Jelski).
46. *Aglæactis castelnaudi* Bourc. et Muls.—Junin, Acancocha (Jelski).
47. *Rhamphomicron microrhynchum* (Boiss.). — Auquimarca (Jelski).
48. *Schistes geoffroyi* (Bourc. et Muls.).—Paltaypampa, Huanta (Jelski).
49. *Leucippus pallidus* Tacz.—Huanta (Jelski), coll. Raimondi.
50. *Stenopsis* "*æquicaudata.*"—Pumamarca (Jelski).
51. *Hydropsalis lyra* Bp. " "
52. *Steatornis caripensis peruviana* Tacz.—Pumamarca (Jelski).
53. *Cypselus montivagus* d'Orb.—Huanta, Pumamarca (Jelski).
54. *Campephilus hæmatogaster* (Tsch.).—Chilpes (Jelski).
55. *Nonnula ruficapilla* (Tsch.).—Amable-Maria (Jelski).
56. *Micrastur gilvicollis* (Vieill.).—Amable-Maria (Jelski).
57. *Ara militaris* (L.).—Amable-Maria (Jelski).
58. *Harpyhaliaëtus coronatus*(Vieill.).—Chanchamayo(Tschudi), Amable-Maria (Jelski).
59. *Falco cassini* Sharpe.—Junin (Jelski).
60. *Columba* "*vinacea* (Temm.)." - Amable-Maria (Jelski).
61. *Zenaida maculata* (Vieill.).—Auquimarca (Jelski).
62. *Tinamotis pentlandi* Vig.—Ninarupa (Jelski).
63. *Mycteria americana* L.—Montaña de Vitoc (Tschudi).
64. "*Nycticorax gardeni* (Gml.)."—Environs de Junin (Jelski).
65. *Phegornis mitchelli* Gray.—Lac Junin (Jelski).
66. *Attagis gayi* Geoffr. et Less.—Ninarupa (Jelski).

Ainsi le nombre des espèces connues de cette région est de 483 + 66 = 549.

Ci-dessous nous donnons la liste des espèces trouvées par feu Jelski à Monterico. Cette localité est située dans la vallée de Choymacota (dép. de Ayacucho), c'est-à-dire un peu plus au sud que la région qui nous occupe. Il est à supposer que la plupart de ces espèces se retrouveront dans les districts de Chanchamayo et de Vitoc.

1. Cyphorhinus thoracicus *Tsch.*
2. Vireo flavoviridis (*Cass.*).
3. Hylophilus flaviventris *Cab.*
4. Vireolanius chlorogaster *Bp.*
5. Phœnicothraupis peruvianus *Tacz.*
6. Lanio versicolor (*Lafr.*).
7. Pitylus grossus (*L.*).
8. Euscarthmus rufigularis *Cab.*
9. Phyllomyias cinereocapilla *Cab.*
10. Myiodynastes luteiventris (*Less.*).
11. Myiobius phœnicurus *Scl.*
12. Empidochanes olivus (*Bodd.*).
13. Contopus plebejus *Cab.*
14. Hadrostomus audax *Cab.*
15. Lipaugus simplex (*Licht.*).
16. Lochmias obscurata (*Cab.*).
17. Sclerurus olivascens *Cab.*
18. Automolus subulatus (*Spix*).
19. Cymbilanius lineatus (*Leach*).
20. Herpsilochmus rufimarginatus (*Temm.*).
21. Myrmotherula cinereiventris *Scl. et Salv.*
22. Hypocnemis myiotherina (*Spix*).
23. " theresæ (*Des Murs*).
24. Campephilus tracheolopyrus *Malh.*
25. Galbula chalcothorax *Scl.*
26. Malacoptila fusca (*Gml.*).
27. Capito auratus (*Dum.*).
28. " aurantiicollis *Scl.*
29. Rhamphastos cuvieri *Wagl.*
30. Mitua mitu (*L.*).
31. Pipile cumanensis (*Jacq.*).
32. Tinamus ruficeps *Scl. et Salv.*
33. Odontophorus pachyrhynchus *Tsch.*
34. Conurus lucyani *Dev.*
35. Chrysotis farinosa *Bodd.*

Les espèces suivantes paraissent propres à la région du Chanchamayo.

1. Turdus phæopygus spodiolæmus.
2. Entomodestes leucotis.
3. Cinnicerthia peruana.
4. Thryothorus cantator.
5. Troglodytes solstitialis macrourus.
6. Basileuterus uropygialis poliothrix.
7. Hylophilus flaviventris.
8. Diglossa pectoralis.
9. Chlorochrysa calliparæa.
10. Iridornis jelskii.
11. „ reinhardti.
12. Pœcilothraupis lacrymosa.
13. „ igniventris ignicrissa.
14. Buthraupis cucullata cyanonota.
15. Dubusia stictocephala.
16. Chlorospingus auricularis.
17. „ chrysogaster.
18. „ cinereocephalus.
19. „ berlepschi.
20. Nemosia pectoralis.
21. Pipilopsis tricolor.
22. „ mystacalis.
23. Buarremon poliophrys.
24. Catamblyrhynchus diadema citrinifrons.
25. Pseudochloris sharpei.
26. Spinus ictericus peruanus.
27. Xanthoura jolyæa.
28. Ochthodiæta signata.
29. Euscarthmus rufigularis.
30. Orchilus albiventris.
31. Cyanotis rubrigastra alticola.
?32. Leptopogon rufipectus.
?33. Capsiempis orbitalis.
34. Phyllomyias cinereocapilla.
35. Tyranniscus frontalis.
36. „ viridiflavus.
37. Chloropipo unicolor.
38. Pipra comata.
39. Hadrostomus audax.
40. Pipreola viridis intermedia.
41. „ elegans.
42. Doliornis sclateri.
43. Geositta saxicolina.
44. Upucerthia pallida.
45. „ serrana.
46. Schizœaca palpebralis.
47. Siptornis humilis.
48. „ taczanowski.
49. „ graminicola.
50. „ virgata.
51. „ albicapilla.
52. Sclerurus olivascens.
53. Thripadectes scrutator.
54. Philydor montanus.
55. Anabazenops rufosuperciliatus cabanisi.
56. Xiphocolaptes phæopygus.
57. Thamnophilus melanurus debilis.
58. „ variegaticeps.
59. Dysithamnus dubius.
60. Myrmotherula sororia.
61. Herpsilochmus motacilloides.
62. Myrmeciza spodiogastra.
63. Chamæza olivacea.
64. Conopophaga castaneiceps brunneinucha.
65. Scytalopus femoralis.
66. „ acutirostris.
67. Eutoxeres condaminei gracilis.
68. Phaëthornis rufigaster longipennis.
69. Lafresnayea saul rectirostris.
70. Spathura annæ.
71. Lampraster branickii.
72. Metallura eupogon.
73. „ opaca jelskii.
74. Eriocnemis sapphiropygia.
75. Oreotrochilus melanogaster.
76. Lampropygia columbiana obscura.
77. Leucippus pallidus.
78. Macropsalis kalinowskii.
79. Chloronerpes chrysogaster.
80. Dendrobates malherbei pectoralis.
81. „ valdizani.
82. Picumnus jelskii.
83. „ punctifrons.
84. Malacoptila fulvigularis melanopogon.
85. Capito glaucogularis.
86. Leptosittaca branickii.
87. Pyrrhura rupicola.
88. Nothoprocta branickii.
89. „ taczanowskii.
90. Rallus nigricans humilis.

Quant aux relations de la faune ornithologique de cette région comparée avec celles des contrées voisines, nous reservons nos remarques pour une époque future, quand ces faunes seront mieux connues qu'elles ne le sont à présent.

4. Note on the Presence of an extra Pair of Molar Teeth in a *Lemur fulvus*. By G. Elliot Smith, M.D., Professor of Anatomy, Egyptian Government Medical School, Cairo[1].

[Received April 3, 1902.]

(Text-figure 1.)

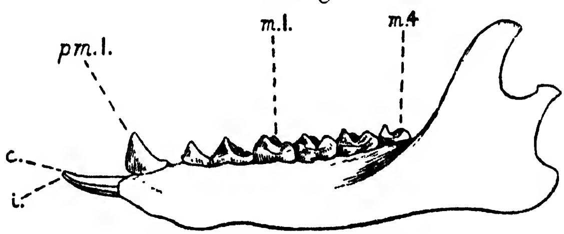
Among a number of Lemurs which Captain Stanley Flower, Director of the Ghizeh Zoological Gardens, has kindly placed at my disposal during the past year was a male *Lemur fulvus* with four molar teeth in each half of the mandible (text-fig. 1).

Dr. Forsyth Major, whom I consulted on this matter as our greatest authority on Prosimian anatomy, deems this anomalous condition worthy of being placed on record.

The individual in which these additional teeth were found had attained to the full adult proportions, but the cranial sutures were still distinct.

The teeth of the maxilla were normal in number, size, and shape. All of the teeth usually found in the mandible of this species of Lemur were also present in this specimen, and none of them deviated in any respect from the condition normal to the species. But there was present behind each third lower molar a tooth of

Text-fig. 1.



Left lateral aspect of the anomalous mandible of *Lemur fulvus*. ♂, nat. size.

approximately the same form and four-fifths of its dimensions. The only difference in shape, which a careful comparison of the third and fourth molars revealed, was due to the diminutive proportions of the postero-external cusp of the latter.

According to Tomes, some of the extinct species of Lemurs have "the full mammalian number of four premolars, and so were . . . less specialized than their recent descendants."[2]

The anomalous case now described is, in a sense, compensatory to the last-quoted, for it possesses four molars and only three premolars.

The tendency to the persistence of the primitive number of four molars is seen in its most pronounced form in the Order

[1] Communicated by Prof. G. B. Howes, F.R.S., F.Z.S.
[2] C. S. Tomes, 'Dental Anatomy,' 5th ed., 1898, p. 501.

Marsupialia. Among the Carnivora, *Otocyon* also retains the four molars, which Huxley considered the primitive equipment of grinders in the Canidæ[1]; and for the Insectivora Oldfield Thomas has recorded the existence of a fourth upper molar in *Centetes*[2].

The occurrence of a fourth lower molar in a recent Lemur seemed to suggest the possibility of an archaic four-molared ancestor of the Primates; but Dr. Forsyth Major informs me that, in his opinion, in the Eutheria a fourth molar is *always secondary*.

5. On some Nudibranchs from Zanzibar. By Sir Charles Eliot, K.C.M.G., Commissioner and Consul-General in the British East-African Protectorate.

[Received April 1, 1902.]

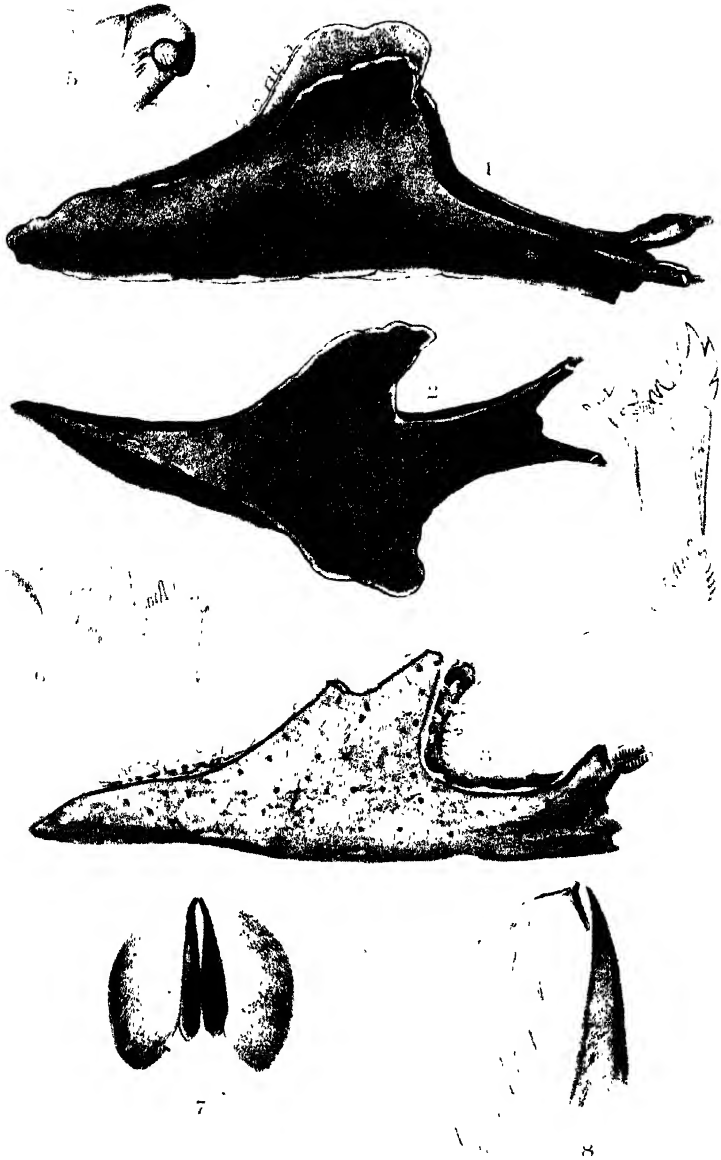
(Plates V. & VI.[3] and Text-figures 2–5.)

During the last year Mr. Crossland has been most kindly investigating for me the fauna of the eastern and western coasts of Zanzibar. He has not only collected a large number of Opisthobranchs, but also greatly increased the value of his collection by drawings of the living animals. The present paper contains some of the results of his labours in the shape of notes on three apparently new genera of Nudibranchs—*Zatteria*, *Dunga* (Æolididæ), and *Crosslandia* (Scyllæidæ), and on two interesting species on which little seems to have been written since the time of Alder and Hancock—*Melibe fimbriata* and *Madrella ferruginosa*. The Æolididæ are already divided into forty or fifty genera, and it is with reluctance that I add to their number, believing that it would more properly be reduced. But as long as the definitions of the existing genera are so minute and narrow, they cannot be made to accommodate fresh forms, for which new, though probably only provisional, genera must be created.

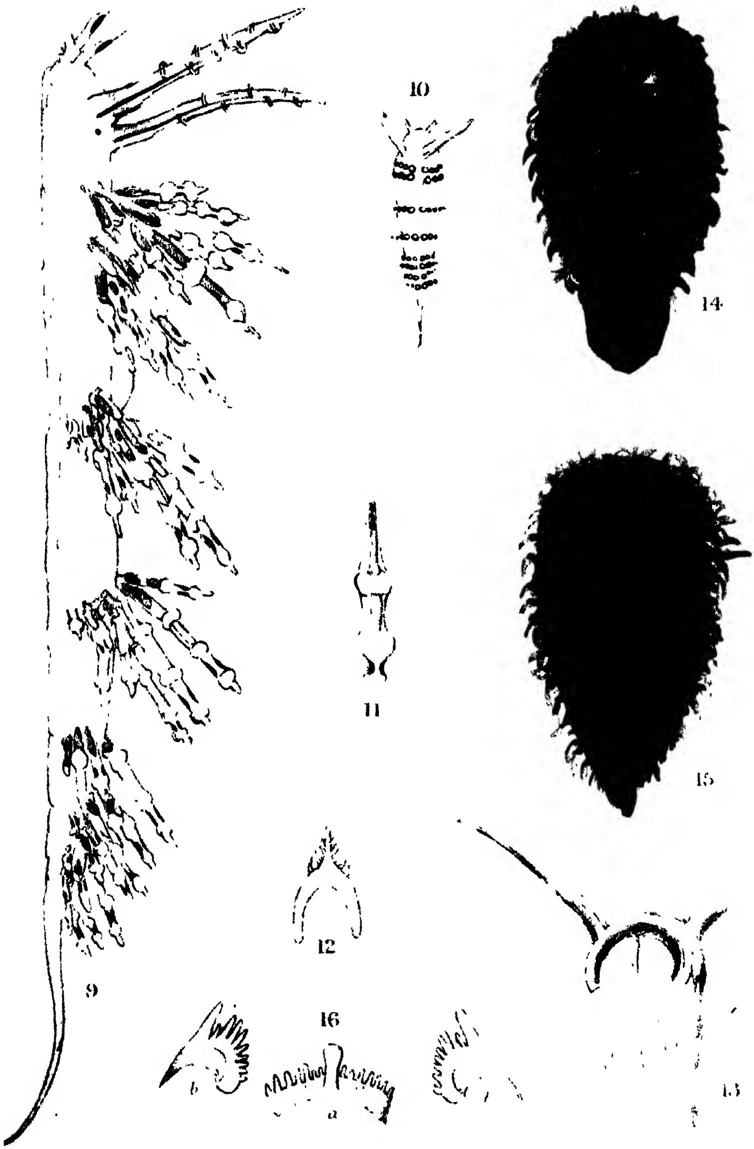
Zatteria browni, gen. et sp. nov. (Plate VI. figs. 9–13.)

Three specimens were found in seaweed collected on the reefs round Prison Island, in Zanzibar Harbour, in May 1901. The largest was ·8 cm. long by ·2 cm. broad. The body is long and narrow, and terminates in a peculiarly slender tail, which is nearly a quarter of the length of the whole animal. The cerata are arranged in eight transverse rows (Pl. VI. fig. 10), each row containing eight cerata, four on each side. The first two rows and the last four are crowded together, but the two series in the middle are separated one from another and from the anterior and posterior clumps by considerable intervals. The most distinctive character of the genus is the shape of the cerata (Pl. VI. fig. 11), which are not even but swell out into two or three projecting rings, the first

[1] P. Z. S. 1880, p. 284. [2] P. Z. S. 1892, p. 503.
[3] For explanation of the Plates, see p. 72.



NUDIBRANCHS FROM ZANZIBAR



Bale & Danielsson L^td lith.

NUDIBRANCHS FROM ZANZIBAR.

a little below the tip. Above the mouth are two short, slender, erect tentacles. Behind them are the rhinophores, which are considerably longer and more slender than the cerata: they bear about eight bracket-like semicircles, which alternate with one another, so that there is not a complete circle round the rhinophore; at the base of each rhinophore is a black eye-spot. The foot is rounded in front and the corners are not produced in tentacle-like expansions (Pl. VI. fig. 13).

The body is translucent and colourless (the viscera being white) with a few blotches formed of opaque white dots. The cerata are also translucent, except at the rings, which are opaque white; they bear a few orange spots or streaks. There is a long orange streak on each rhinophore.

The jaws are small and the masticatory edge is finely denticulate. The radula is short and uniseriate. Each tooth is shaped like a horse-shoe and bears on its anterior margin one large denticle with six small ones on each side (Pl. VI. fig. 12). No trace of armature was discoverable in the reproductive organs.

In many characters, in the disposition of the cerata, the rounded anterior margin of the foot, and the buccal parts, the animal appears allied to *Cratena*; but it differs in two points, the rudimentary perfoliation of the rhinophores and the rings round the cerata. The latter peculiarity is, so far as I am aware, unrecorded among the Æolids, but it almost entirely disappears in specimens preserved in alcohol, and it is therefore possible that it may really exist in other genera which have been described from such specimens.

DUNGA NODULOSA, gen. et sp. nov.

This animal is fairly common on colonies of *Sertularia*. The body and tail are both long. The cerata are easily detached and have then some power of independent movement. They are carried very erect in the living animal and are set in transverse rows varying from four to six in number. Behind the last transverse row is a clump of smaller cerata, also of varying number. Probably the caducous character of the appendages has something to do with these variations. Each transverse row consists of ten cerata, gradually increasing in size from the outside to the centre, the two middle ones being much larger than the others. The outer cerata are of the ordinary cylindrical shape; the middle ones are swollen and ovate, but terminate in a fine point. At the top of the broad part and at the base of this point are eight knobs. The rhinophores are very long and simple. The tentacles are moderately long, and the anterior angles of the foot are produced into processes of about the same length. The foot is narrow and without markings. The length varies from ·5 to 1·2 cm.

The coloration is very variable and ranges from clear light yellow to purplish brown. These differences may be partly due to two different colours of the liver diverticula seen in the

transparent cerata. But in all cases the tips of the cerata are pink and the knobs of a brilliant white, with a white streak extending upwards and sometimes with white spots below. The back, cerata, rhinophores, and tentacles are covered with small spots of the same colour as the body but darker. The rhinophores have usually, but not always, dark circular bands. The intestines, which are clearly visible, are light or dark yellow.

The jaws are of moderate size; the masticatory edge is bluntly denticulate, but on the lower part only. The radula consists of a single row of teeth. The central part of each tooth is prolonged into a short bluntish point; on either side are three denticulations. I could discover no armature in the reproductive system.

The general characters and inflated cerata of this genus resemble the *Tergipedinæ*, and the figures of *Capellinia capellinii* (by Trinchese) and those of *Tergipes* (*Capellinia*) *doriæ* (by Vayssière) represent the cerata of these species as nodulous. But the *Tergipedinæ* have the foot rounded anteriorly, and the arrangement of the cerata in this animal is peculiar; it therefore seems necessary to create a new genus for it.

CROSSLANDIA VIRIDIS, gen. et sp. nov. (Plate V. figs. 1–8).

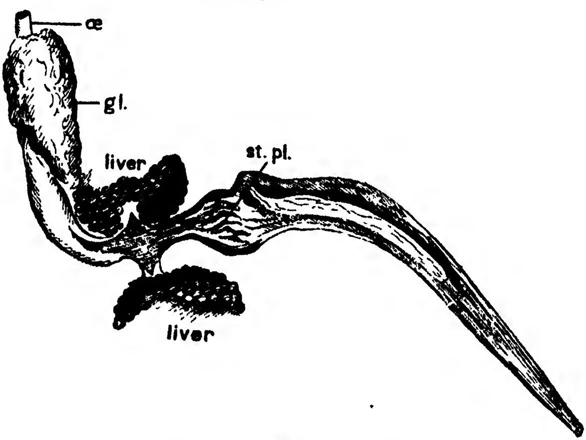
In July and September, 1901, were captured at Zanzibar four specimens of a nudibranch closely allied to *Scyllæa*, though strikingly different in external appearance. The four specimens seem to constitute a new genus and possibly two species, though one may prove to be merely a well-marked variety. The animal in question may possibly be a *Nerea*, Lesson. I have not access to the original authorities, but Fischer's 'Manuel de Conchyliologie,' p. 536, says: "Le genre *Nerea*, Lesson, 1830, a été placé dans le voisinage des *Scyllæa*. Rhinophores courts, coniques, ciliés, visibles au dessus d'un petit voile frontal: tête courte, tronquée en avant; corps fournissant de chaque côté deux lobes; branchies disposées en petites touffes sur les lobes latéraux et sur la queue." From this description and from the fact that Bergh, in his 'System der Nudibranchiaten Gasteropoden,' takes no notice of *Nerea*, it may be presumed that the characters are not sufficiently defined to constitute a valid genus.

The length of a large specimen is nearly 5 centimetres, and the general appearance superficially resembles *Elysia* and in no way recalls *Scyllæa*, which, however, I have never seen alive, although I have examined numerous alcoholic specimens. The body is fairly long; it is produced into a neck and tail and laterally into two wing-like lobes, one on each side, which are more or less distinctly bifid, but in no specimen can be compared to the two pair of cerata found in *Scyllæa*, and are not constricted at the base. The animal when crawling generally directs them laterally. The colour is vivid green, harmonizing exactly with the young leaves of *Zostera* on which the animal was found. At the side of the body below the lobes is a row of irregular projecting sandy

markings. Round the edges of the lobes, the angles of the body, the ridge of the tail, the cups of the rhinophores, and the frontal veil runs a brown line. The surface of the body is covered with microscopic brown specks, which here and there are aggregated into spots just visible to the naked eye. There are also a few other spots.

There are no anterior tentacles, but a small frontal velum. The rhinophores are perfoliate and set in little open cups on the top of fairly long pillars, which are usually held nearly horizontally and have not any process behind as in *Scyllæa* (see Pl. V. fig. 5). The back and inside of the wings are covered with colourless, transparent contractile branchiæ similar to those of *Scyllæa* (text fig. 3, p. 66). On the tail is a slight ridge, not amounting to a crest. The foot is very narrow.

Text-fig. 2.

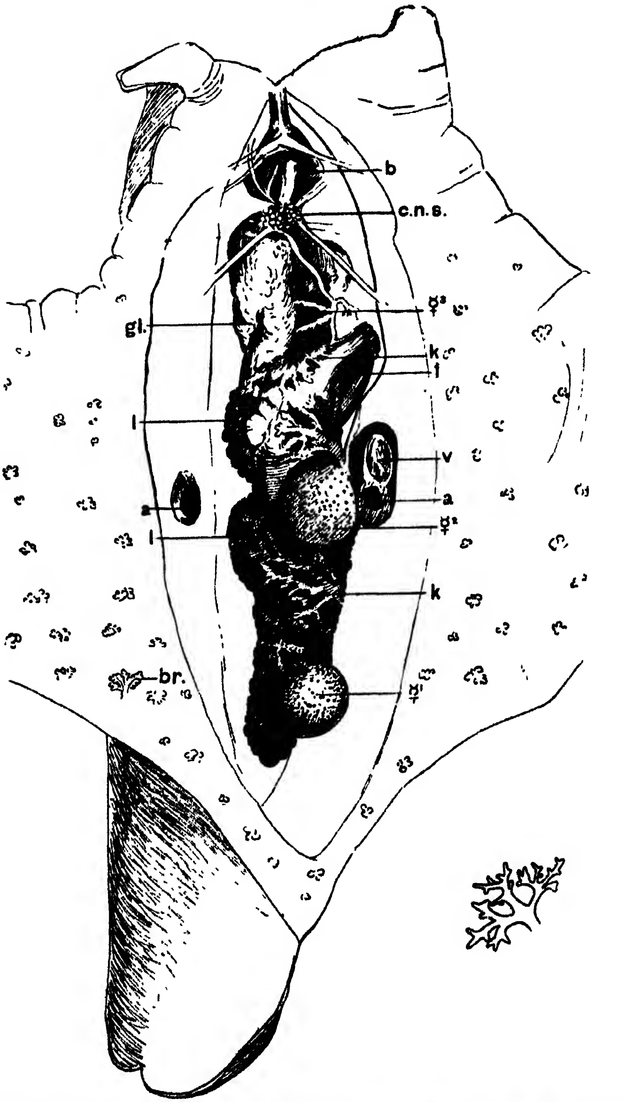


Digestive organs of *Crosslandia viridis*.

œ., œsophagus. | *gl.*, gland. | *st.pl.*, stomach-plates.

The body-cavity is spacious anteriorly until the commencement of the liver. After this point it is quite narrow, owing to the thickness of the soft transparent body-wall. The jaws (Pl. V. figs. 7, 8) are large and hinged dorsally. The masticatory edge is smooth and flexible, of a deep brown colour and bent outwards, the muscles being attached at the bend and covering the large stiff cheeks. The radula (Pl. V. figs. 4, 6) is short; each row consists of a median tooth and about 30 laterals on each side. The median tooth has a fairly large spine in the centre of the anterior margin and about 5 denticulations on each side, of which the pair nearest the centre are considerably larger than the others. The lateral teeth are also denticulate, but vary somewhat in form, and the corresponding teeth in the different rows do not always

Text-fig. 3.



General view of the intestines of *Crosslandia viridis*.—The body has been opened by a cut made somewhat to the right and dividing the heart in two.

a., auricle.
b., buccal mass.
br., branchial tuft.
c.n.s., central nervous system.

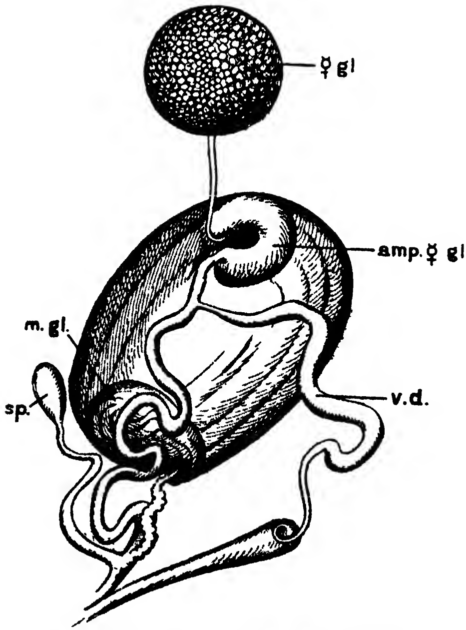
☿^{1}, ☿^{2}, ☿^{3}, three hermaphrodite glands.
gl., gland on œsophagus.
i., intestine.

k., kidney.
l., liver.
v., ventricle.

One branchial tuft enlarged is shown separately.

agree in shape. Those nearest the rhachis are generally denticulate on both sides: the ordinary teeth are denticulate only on the external side: those towards the end of the row are again denticulate on both sides but of a peculiar form; the outermost are degraded. On the œsophagus lies a large gland of apparently salivary functions. The œsophagus, which is narrow, broadens at this gland, and the digestive tract continues of much the same length until near its termination. On slitting it open (text-fig. 2, p. 65) the traces of a stomach are found, and an internal constriction is caused by the presence of a ring of large horny teeth. Just beyond this point is a large typhlosole with an irregularly laminated interior surface. The anus is lateral, beneath the right wing. The liver is in two compact masses, anterior and posterior; they send forth very slender light green diverticula, which until carefully examined have rather the appearance of veins, to the base of the wings and rhinophores.

Text-fig. 4.



Hermaphrodite gland of *Crosslandia viridis*.

amp. ☿ *gl.*, ampulla of hermaphrodite gland.
☿ *gl.*, one of the three portions of the hermaphrodite gland.
m.gl., mucous gland.
sp., spermatotheca.
v.d., vas deferens.

The ganglia in the central nervous system are distinct, the pedal being ventral to the œsophagus.

The pericardium (text-fig. 3, p. 66) is embedded in the body-wall: its pulsations are visible externally.

The kidney (text-fig. 3) is spread over the liver, and also on its ventral surface, as a number of distinct branching tubes, which continue in front of the liver, lying loosely in the body-cavity.

The hermaphrodite gland (text-fig. 4, p. 67) consists of three granular, spherical bodies, somewhat on the right side of the liver, one at each end and one in the middle, but not fused with it or embedded in it. The ampulla is large. There is only one spermatotheca. Prostates are absent, and the penis is small and unarmed.

It will thus be seen that in its internal structure this animal closely resembles *Scyllæa*. The only important difference is that the hepatic diverticula are very small and extend only to the bases of the wings, whereas in *Scyllæa* (? in all species) they are said to penetrate to the ends of the cerata and into the branchial tufts. I have wondered whether the creature could be a young *Scyllæa* in which the bifid lobes would subsequently divide into two pairs of cerata, but the size, which is as large as that of most *Scyllææ*, renders this improbable. Taken in conjunction with the character of the liver, the external differences (the wings instead of two pairs of cerata, the absence of a caudal crest and of flaps behind the rhinophores) seem sufficiently great to warrant the creation of a new genus, which I have named *Crosslandia* after Mr. Crossland, who dredged the first specimen.

One of the specimens (Pl. V. fig. 3) showed marked peculiarities, and is certainly a well-defined variety if not of a distinct species. The body was stouter and the outline more wrinkled and indented. The colour was that of *Fucus*, with a few pointed sandy projections and coralline purple spots. If it proves to be a distinct species I would call it *C. fusca*.

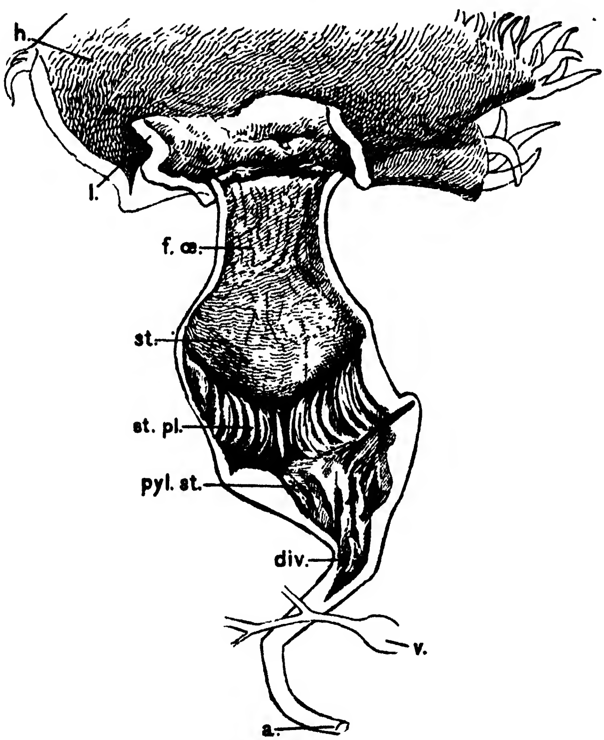
Melibe fimbriata Ald. & Hanc. Trans. Zool. Soc. vol. iii. pp. 137–139 (1864).

A large number of specimens of this remarkable animal were captured on both the east and west sides of Zanzibar in 1901. Alder and Hancock's figure and description give a good idea of its external appearance; but the coloration is very variable, ranging from clear bright yellow to ashy grey. Sometimes the colour is uniform, but more often the surface of the body and of the papillæ is marked with irregularly disposed spots and blotches, which may be black, white, grey, or sandy. These markings harmonize with the ordinary environment of the creature, and cause it to closely resemble a piece of seaweed besprinkled with sand and partially encrusted with sponges and other animal growths. In full-grown and perfect specimens, which are six inches long or more, the number of papillæ seems to be six or seven on each side of the body; but they are very easily detached, and few individuals have the two series complete.

I also found Alder and Hancock's description of the internal

anatomy to be correct, particularly as regards the absence of jaws. They say: "In *Melibe* the buccal organ is provided with neither tongue, jaws, nor collar." Bergh, in his monograph on the genus (in Malac. Untersuch. in Semper's Reisen, Th. ii. Bd. i. p. 363), thinks this statement will probably prove incorrect as other species of *Melibe* are provided with jaws, and he gives as a generic character: "Bulbus pharyngeus cum mandibulis aliquantulum ut in *Phylliroidis*: margo masticatorius mandibulæ fortiter dentatus."

Text-fig. 5.



Melibe fimbriata.

a., anus.
div., diverticulum.
f.œ., folds of œsophagus.
h., hood.
l., lip.
pyl.st., pyloric portion of stomach.
st., thin-walled stomach.
st.pl., belt of stomach-plates.
v., ventricle of heart.

Mr. Crossland and I have, however, dissected several specimens of *Melibe fimbriata*, and in all failed to detect any trace of jaws. Our drawing (text-fig. 5) will perhaps explain clearly the structure of the digestive tract. In the centre and bottom of the hood is a protruding, circular, fleshy lip. This leads straight into the

œsophagus, which is provided with a series of folds, but no hard armature of any kind. The stomach is set with a belt of horny plates of two sizes and usually alternating regularly, the small being next to the large. The pyloric portion of the stomach below this belt is provided with muscular ridges, and passes almost imperceptibly into the intestine. At the point where it begins to be constricted is a pouch-like diverticulum with a laminated interior.

With the exception of the absence of jaws, the other characters of this animal clearly connect it with *Melibe*, not *Tethys*. The foot is very narrow, the body rather high and compressed; the cerata are covered with knots; the buccal opening passes straight into the œsophagus; the stomach is armed with plates; the liver is long and follicular and does not extend far into the cerata; the hermaphrodite gland is composed of many separate lobes at the side and under the liver. In *Tethys*, on the contrary, the foot is broad and the body flat; the cerata are smooth; there is a division of the alimentary canal before the œsophagus which may be called a buccal cavity; the liver is a compact mass sending diverticula to the ends of the cerata; the hermaphrodite gland forms a thick covering over the liver. Further, *Tethys* is described as possessing true branchiæ set at the base of the cerata. The back of *Melibe fimbriata* is covered with branched papillæ which bear a superficial resemblance to gills, but I could not discover that they have any special connection with the vascular system, and they seem analogous to the ramose appendages of *Plocamophorus* and some species of *Notarchus*.

It would thus appear that *Melibe fimbriata* is intermediate between *Tethys* and the jaw-bearing species of *Melibe*. It does not, however, seem necessary to create a new genus, but rather to modify the existing description of the genus and say *jaws present or absent*. The shape of the foot, body, and cerata, the presence of stomach-plates, the absence of branchiæ, and the character of the liver distinguish it sufficiently from *Tethys*.

In spite of its want of jaws, *Melibe fimbriata* is a most voracious animal, and I more than once found in the stomachs which I examined limbs of crustacea more than an inch long. The way in which it captures its prey is extremely curious. The circular oral veil acts as a net with an elastic rim. When seeking for food it expands the net and sweeps with it the surface over which it is crawling. The skin of the hood is stretched so tight as to be quite transparent and the marginal cirri are almost invisible. The moment a small crustacean or other prey is caught the net closes up, the cirri almost unite on the under surface, and the skin ceases to be perfectly transparent. Then the *Melibe* tosses the hood, which has now practically become a closed sac, backwards, and creates a current of water with the cirri, which forces its prey towards its mouth. The movements of the animal are rapid and energetic, whether it crawls or swims. It can also float on the surface foot uppermost.

MADRELLA FERRUGINOSA. (Plate VI. figs. 14–16.)

Madrella ferruginea Ald. & Hanc. Trans. Zool. Soc. iii. pp. 141–2 (1864).

No fresh details have, I believe, been published respecting this genus since Alder and Hancock's description. I have seen two specimens at Zanzibar, one about half an inch long and the other nearly double the size. The colour of the body is a deep coppery red. Round the edge of the mantle, including the anterior margin, are transparent copper-coloured cerata, into each of which passes a very short diverticulum of the liver. The black or deep purple ramifications of the liver are visible through the dorsal integuments. There are many more cerata in the large than in the smaller specimen, and it is therefore possible that they increase with age. The middle of the dorsal area is bare, except that it carries several irregularly distributed tubercles or papillæ. In the large specimen they pass between the rhinophores and form a sort of rudimentary crest, but in the smaller specimen, though they occur on the back, they do not pass between the rhinophores. The large specimen had a white blotch between the rhinophores, the smaller none. The form of the rhinophores is somewhat unusual. They are not perfoliate, but there is a circle of papillæ round the top of the club, somewhat as in *Tritonia*. There are no anterior tentacles, but the head is very broad and crescent-shaped, with produced ends. The front of the foot is wide and square, but the corners are not prominent. The mouth is ventral. Both the mantle-edge and the foot are wide, but between them is a deep groove. In crawling the foot projects beyond the mantle. The mantle overhangs the head and forms a wide frontal veil. The genital orifices are in the anterior part of the right-hand side, the anus in the posterior part, distinctly lateral and not dorsal.

The internal anatomy, so far as I could examine it, agreed with the description of Alder and Hancock. I was unable to see any salivary glands. The jaws are very large, enclosing the buccal mass, but not denticulate. The radula (Pl. VI. fig. 16) is triseriate and long. The median tooth has a strong blunt spine in the centre and about 7 denticulations on each side. The laterals have a large spine on the outer margin and 8 or 9 denticulations on the inner side. These denticulations seem therefore somewhat less numerous than those described by A. & H. The ganglia in the central nervous system are very distinct. *Madrella* appears to be sluggish in its movements. In confinement it discharged some fluid, which imparted a ferruginous colour to the water round it. This discharge did not appear to proceed from any particular organ, but from the whole surface of the body.

The genus forms an interesting connecting link between the Janidæ and other Æolidæ. The arrangement of the liver and cerata connect it decisively with the former, but in its lateral anus and triseriate radula it approaches the general characters of the group and departs from the exceptional peculiarities of the Janidæ,

which have a dorsal anus and a multiseriate radula. As a family the Janidæ are characterized by the presence of hepatic diverticula and of cerata in the anterior portion of the dorsal surface, in front of the rhinophores. Another character peculiar to the family, but not universal in it, is the crest between the rhinophores. There are four well-marked genera:—*Madrella*, with lateral anus, triseriate radula, papillous rhinophores, a rudimentary crest, and jaws without teeth. The other three genera have the additional peculiarities of a dorsal anus and a multiseriate radula. *Proctonotus* has simple rhinophores, no crest, and jaws without denticles. *Janolus* has perfoliate mandibles and very large jaws without denticles; the foot is also exceptionally broad. *Janus* has perfoliate rhinophores, a toothed mandible, and a crest.

EXPLANATION OF THE PLATES.

Plate V.

Figs. 1, 2. *Crosslandia viridis*, p. 64.
3. " " var. (?) *fusca*.
4. " " outer teeth of two consecutive rows of the radula.
5. " " rhinophore cup, one side removed.
6. " " central and inner teeth of radula.
7. " " jaws, from in front.
8. " " jaws, from the side.

Plate VI.

Fig. 9. *Zatteria browni*, p. 62.
10. " " diagrammatic view showing position of cerata.
11. " " one of the cerata.
12. " " tooth of radula.
13. " " view of head from below.
14, 15. *Madrella ferruginosa*, p. 71, dorsal and ventral view.
16. " " one row of radula—*a*, median; *b*, *b*, lateral teeth.

June 3, 1902.

Dr. Henry Woodward, F.R.S., Vice-President, in the Chair.

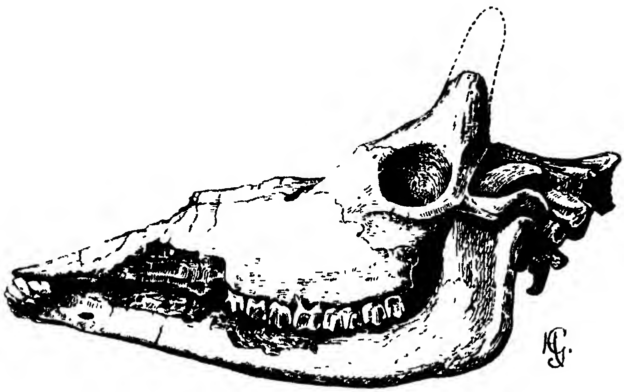
Mr. W. L. Sclater, F.Z.S., made some remarks on the present condition and future prospects of the Zoological Museums of South Africa, most of which he had recently visited. These were altogether eight in number, four of which were in the Cape Colony—namely, the South African Museum at Cape Town, the Albany Museum at Grahamstown, the King-William's-Town Museum, and the Port Elizabeth Museum. In Natal there were Museums at Durban and Pietermaritzburg, in the Transvaal the Museum at Pretoria, and in the Orange River Colony the National Museum at Bloemfontein.

Mr. Boulenger exhibited a strap made of Okapi skin, which had been received, along with other ethnographical curiosities, at the Abbey of Maredsous, in Belgium, in December 1899, thus some time previous to the arrival in this country of the piece of skin on which "*Equus johnstoni*" (P. Z. S. 1901, vol. i. p. 50) had been founded. This object had been obtained by M. E. Vincart, a lieutenant in the service of the Congo State, in the Mangbettu

country (lat. 3° N., long. 28° E.), where, according to his statement, chiefs alone have the privilege of wearing straps or belts made of the skin of what he had regarded as a rare Antelope.

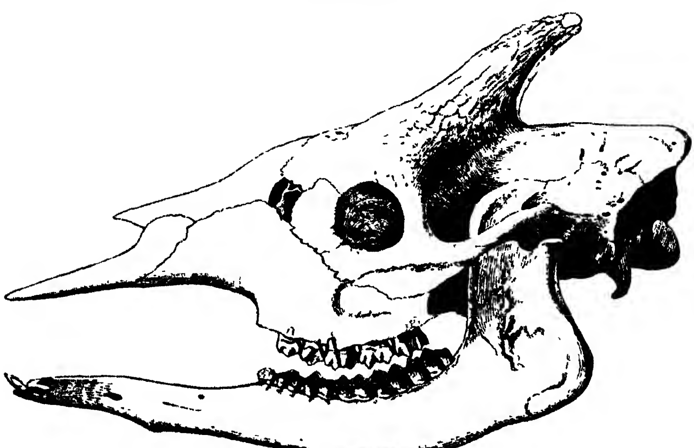
Dr. C. I. Forsyth Major, F.Z.S., informed the meeting that the remains of Okapi received by the Congo Museum in Brussels[1], which he had lately had an opportunity of examining, consisted

Text-fig. 6.



Left side view of skull of *Samotherium boissieri* Maj., ♂, from Samos. $\frac{1}{8}$ nat. size.

Text-fig. 7.



Left side view of skull of *Okapia liebrechtsi* Maj., ♂. $\frac{1}{8}$ nat. size. From Mundalah, on the road from Mawambi to Beni (N.E. frontier of the Independent Congo State). Congo State Museum at Tervueren, nr. Brussels.

of the skin of a female and the almost complete skeleton of an adult male. A reduced photographic view of the skin and a

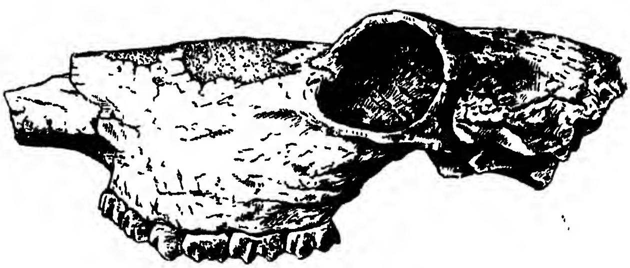
[1] See 'La Belgique Coloniale,' May 4th & 25th, 1902.

sketch of the natural size of the male skull were exhibited, and the following remarks were made:

The new materials supply the eagerly looked for information as to the adult condition of the Okapi and the cranial differences between the two sexes. It will be remembered that even the larger of the two skulls received in London, which was believed to belong to the mounted skin, is that of a youngish individual, retaining most of the deciduous teeth, and that the sex of neither of the two skulls was established.

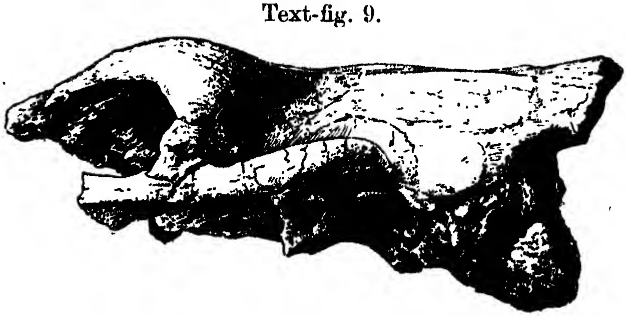
It will be further remembered that, although Sir Harry Johnston from the beginning very appropriately compared the Okapi with the *Helladotherium*, which is an early type of the Giraffidæ, and even assigned it to that genus, the predominating note of almost all the scientific, as well as the more or less popular, writings on the Okapi has been so far to regard it as a kind of degraded or degenerate Giraffe a multiple armament of the skull being regarded as a primitive condition in Ruminants generally and in Giraffidæ in particular.

Text-fig. 8.



Left side view of incomplete hornless skull of *Palæotragus rouenii* Gaud., adult ♀. From Samos. Stuttgart Museum. $\frac{1}{3}$-$\frac{1}{4}$ nat. size.—This specimen is referred to in Geol. Mag. (4) viii. p. 354 (1901). The inflated condition of the orbital roof is not so well shown as in the specimen text-fig. 9, owing to the different position in which the original photograph was taken.

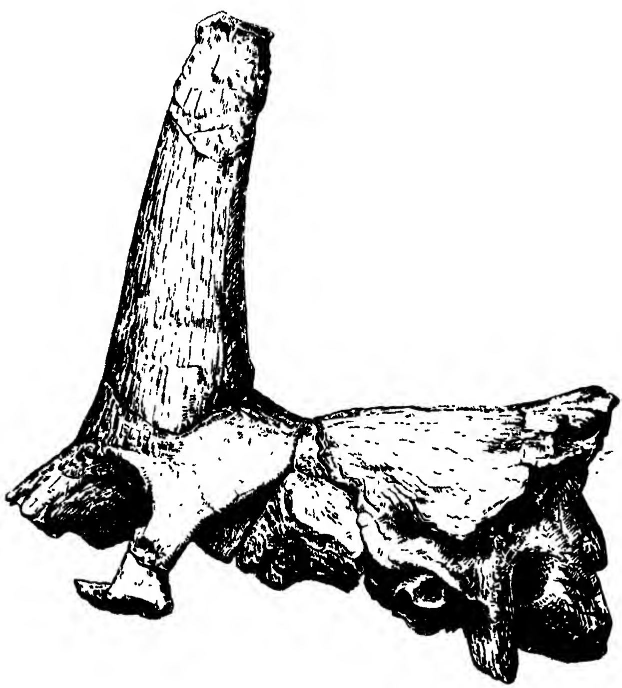
Text-fig. 9.



Cranial portion of hornless skull, left side, of *Samotherium boissieri*, adult ♀. From Samos. Collection of Monsieur William Barbey, Valleyres (Switzerland). About $\frac{1}{4}$ nat. size.

At the bottom of this prevailing idea, which is disproved by all the teachings of palæontology, seems to be the very widespread belief, nurtured by popular works and by museum show-specimens, that all past faunas are made up of "extinct monsters"; whereas in reality in past times it is only a comparatively few highly specialized and decadent forms—ends of a series and not beginnings—that present such peculiarities as to justify that name.

Text-fig. 10.



Cranial portion of skull of *Samotherium boissieri*, ♂, right side (reversed in the fig.) From Samos. Barbey Collection, no. 17. About ¼ nat. size.

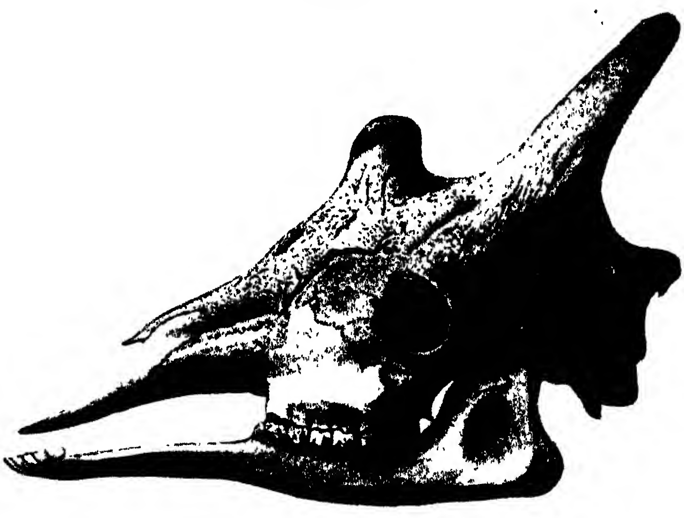
The, geologically speaking, most ancient undoubted Giraffidæ have been found in the uppermost Miocene of Pikermi, Samos, and Maragha; amongst them there is a group, assigned to two genera, *Palæotragus* and *Samotherium*, which possesses all the requisite characters of ancestors of the recent *Giraffa*. The females were hornless (text-figs. 8 & 9). In both sexes there is no trace of swelling at the root of the nasals, and the air-cavities generally are much less developed than in *Giraffa*, being chiefly limited to the roof of the orbits. The horns, where present (text-figs. 6 & 10), are restricted to the frontals, as in the new-born male of the northern Giraffe. The neck was comparatively short;

the limbs of moderate length, the anterior being scarcely longer than the posterior.

Text-fig. 11.

Skull of *Giraffa camelopardalis capensis*, ♂. Left side view. After de Winton (P. Z. S. 1897, p. 281, fig. 4).

Text-fig. 12.

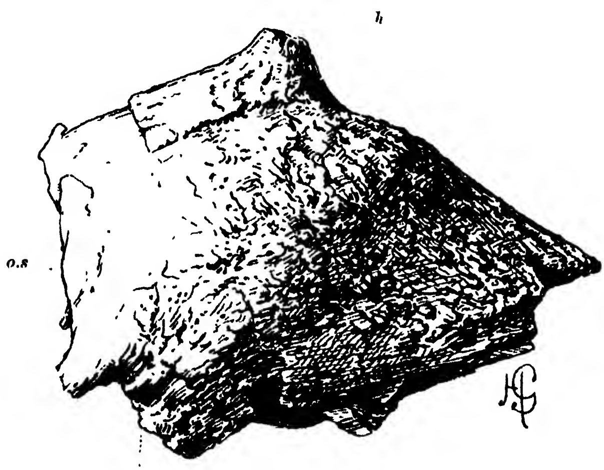


Skull of *Giraffa reticulata*, ♂. Left side view. After de Winton (P. Z. S. 1897, p. 280, fig. 2).

The new materials in the Congo Museum show that the adult Okapi is endowed with two frontal horns. In the female they are small, conical, inserted almost vertically, and completely covered by the skin. In the male they are larger, directed obliquely backwards and somewhat triangular; that the tips of the horns were not covered by skin seems certain, inasmuch as they have a polished appearance. There is no third median horn as in the skull of the northern Giraffe (text-fig. 12, p. 76); the osseous protuberance corresponding to this horn is in the Okapi (text-fig. 7, p. 73) less developed than in the Cape Giraffe (*Giraffa camelopardalis capensis*) (text-fig. 11).

We may say, in a general way, that the skull of the Okapi differs from the Giraffe skull in the lesser development of all the osseous protuberances and sinuses. In this respect the Okapi is intermediate between the Giraffe and *Samotherium*, as characterized above. Even in the adult *Samotherium* (text-fig. 13) the sinuses are much less developed than in a young Okapi still retaining most of the deciduous teeth.

Text-fig. 13.



Supraorbital portion of left frontal of *Samotherium boissieri* (adult ♀ or immature ♂?), showing a rudimentary horn-core. Nat. size. Samos. Barbey Collection, no. 712.—The specimen is referred to in Geol. Mag. (4) viii. p. 243 (1901), where it is erroneously assigned to the right side.

h=rudimentary horn-core; *o.s*=upper margin of left orbit; *p.o*=orbital process of frontal.

The Okapi is besides intermediate between these Miocene forms and the recent Giraffe in the *position* occupied by the frontal horns. In the *Samotherium* the horns, as mentioned, are situated above the orbits; they are situated slightly farther backwards in the Okapi, but stop at the coronal suture; whereas in *Giraffa* they encroach considerably on the parietals.

The four or five stages in the evolution of the Giraffine skull are therefore, beginning from the most generalized:—

1. Hornless—presumably female—*Palæotragus* (*Samotherium*) (text-figs. 8 & 9, p. 74).

1 *a*. Horned skulls of *Palæotragus* (*Samotherium*) (text-figs. 6, p. 73, & 10, p. 75); all presumably males.

2. *Okapia* (text-fig. 7, p. 73).

3. *Giraffa camelopardalis capensis* (text-fig. 11, p. 76).

4. *Giraffa reticulata* (text-fig. 12, p. 76).

As to the dimensions and proportions of the limbs and neck, the skeleton shows, still more conclusively than the skin, that the Okapi scarcely differed in this respect from the ordinary type of Ruminants.

In the Giraffe, as is well known, both fore and hind limbs are much elongated, the former longer than the latter. By adding together the longitudinal dimensions of the three principal bones in each of the limbs, viz., humerus, radius, and metacarpal in the anterior, and those of the femur, tibia, and metatarsal in the posterior, we arrive at the following proportions of the two:—

	Ant. Post.	
Cape Giraffe (Gaudry)	2010 : 1835	= 1000 : 912·9
Abyssinian Giraffe (Brit. Mus.) ...	2256 : 2079·5	= 1000 : 921·8
Senegal Giraffe (Gaudry)	1770 : 1690	= 1000 : 954·8
Okapi	948 : 974	= 1000 : 1027
A species of *Palæotragus* (*Samotherium*)	1295 : 1304	= 1000 : 1007

In the Antelopes and Ruminants generally the hind limb is almost always longer than the fore limb; in some Antelopes, however, both have almost equal length, but the radius is always shorter than the tibia (*Gaudry*). Taking, therefore, the length of the radius as 100, we find the following proportions between the length of the radius and the tibia:—

	R.	T.
Taurotragus oryx	100	120
Hippotragus equinus	100	118·8
Bos	100	117
Okapia	100	99·7
Three species of *Samotherium* (*Palæotragus*) ...	100	98 / 97 / 95
Helladotherium duvernoyi from Pikermi	100	86
Senegal Giraffe	100	83
Abyssinian Giraffe	100	79
Cape Giraffe	100	75

The fore and hind limbs are therefore of about equal length in the Okapi, and the same may be said of the *Samotherium* group. In the Giraffe the fore limb is *longer*, and in Ruminants generally it is *shorter*, than the hind limb.

The longitudinal dimensions of the *cervical vertebræ* show the

neck of the Okapi to have had normal proportions; in the mounted skin in the British Museum the neck appears to me to be a little too much stretched.

In conclusion, and in harmony with what I formerly have said here and elsewhere, the Okapi, far from being a degenerate Giraffe, is, in my opinion, a member of the Giraffidæ which in various respects has retained the characters of ordinary Ruminants. It is a stage towards the Giraffe, slightly less primitive than *Samotherium*, and occupying, on the whole, a perfectly intermediate position between the latter and the true recent Giraffes, which are an extreme.

Mr. Edward J. Bles, F.Z.S., exhibited young tadpoles of *Xenopus lævis* Daud., the Cape Clawed Frog, under the microscope, to demonstrate the remarkable transparency of the head and the method of ingesting food, hitherto unknown in the Amphibia. The results obtained by Mr. F. E. Beddard (P. Z. S. 1894, p. 101) were confirmed. The presence of pectoral lymph-hearts from a very early stage and the absence of blood-vessels in the tail-fin of the young tadpole were briefly referred to.

Mr. Lydekker exhibited the mounted head of a male Siberian Wapiti, *Cervus canadensis asiaticus* (Severtzoff), shot by Mr. J. Talbot Clifton in North Siberia. This Wapiti appeared to be entitled to subspecific distinction from the Thian Shan Wapiti, *C. c. songaricus*, since the dark markings on the muzzle were different, and there also seemed to be certain differences in the antlers, which in the specimen exhibited had a relatively small spread, although they were very massive. In this connection Mr. Lydekker alluded to the head of a Wapiti from Chenkend (?=Chimkent), Turkestan, lately presented by the President to the British Museum. This specimen (No. 2.3.19.1) differed from both the Canadian and the Thian-Shan Wapitis by the whole margin of the upper lip being light-coloured, instead of only the front portion and a patch beside the nostrils, and also by the circumstance that the dark patch on each side of the lower lip did not extend downwards to join a larger patch on the chin, which in this specimen was uniformly light-coloured. Similar features occurred in the Deer from Turkestan to which the name *Cervus bactrianus* had been applied by Mr. Lydekker in 1900. And although that Deer had been regarded as allied to the Shou, Mr. Lydekker now believed its antlers were abnormal, and that it was really a Wapiti. This being so, the British Museum specimen probably belonged to the same form, which might be known as the Turkestan Wapiti, *C. canadensis bactrianus*. It was added that as the "moustache-markings" were constant in the different forms of Roe, they probably were likewise so in the Wapiti group. They were more convenient to describe than the antlers, although these also appeared to differ in the various Asiatic races of Wapiti.

The following papers were read :—

1. The Wild Sheep of the Upper Ili and Yana Valleys. By R. Lydekker.

[Received April 5, 1902.]

(Plates VII. & VIII.[1] and Text-figures 14 & 15.)

Among several other valuable specimens from the same locality, Mr. St. George Littledale has recently presented to the British Museum the head of a male Wild Sheep of the Argali group (Pl. VII. fig. 17), as well as the entire skin of a second individual of the same species, killed in one of the tributaries of the Ili Valley on the northern flank of the eastern Thian-Shan, some distance to the south-east of Kuldja or Ili. Both specimens are in the winter-coat; and the head is now mounted and exhibited in the lower mammal gallery.

As soon as the head was placed in its present position it became apparent that it could not be identified with any of the forms of Wild Sheep exhibited in the gallery, and as it is necessary that it should be named, I lay before the Society the present notes. It may be premised that, being unable to identify this sheep with any named form, I have given it a new subspecific name. This name must, however, be regarded as in some degree provisional, since this sheep may turn out to be inseparable from one of those named, but somewhat insufficiently described, by Severtzoff. To settle this point requires a journey to Moscow, which I am not at present prepared to undertake. It may be added that if the Ili sheep were identified with one of those named by Severtzoff, it would probably involve changing the name *Ovis sairensis*, applied by myself a few years ago to a wild sheep from the Saiar Mountains.

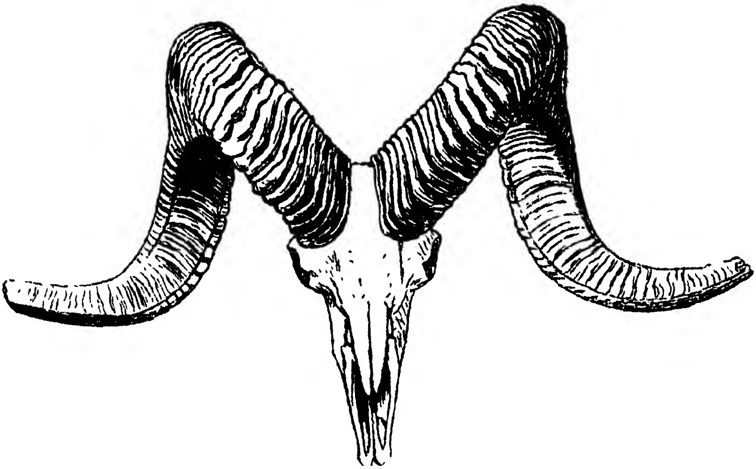
Before proceeding further it may be well to mention that Mr. Littledale has in his own possession the skull of the ram the skin of which he has presented to the Museum. This skull, as shown by the condition of its cheek-teeth, is that of a fully adult individual. The horns are practically similar to those of the Museum specimen, indicating that the latter is also fully adult, as indeed might be inferred from its large size. A skull (text-fig. 14), from Tarbagatai in the Altai, presented by Mr. Littledale in 1896 to the Museum (No. 96.2.6.9), agrees in the characters of the horns with the last-mentioned specimen, and evidently belongs to the same or a closely allied form.

Comparing the Ili specimen with the heads of adult rams of *Ovis ammon* and *O. poli* in the collection of the Museum (of the former of which a figure is given [text-fig. 15, p. 81] in order to facilitate the comparison), it will be seen to differ markedly from both in two respects. In the first place, instead of the entire

[1] For explanation of the Plates, see p. 85.

head being of a "whity-brown" or dirty white colour, its upper portion is greyish brown, while the lower half is pure white. In the second place, the horns rise from the skull at a much greater

Text-fig. 14.



Skull of male of Littledale's Ili Sheep from Tarbagatai.

Text-fig 15.

Head of a male Siberian Argali from the Altai.
(Blanford, Proc. Zool. Soc. 1896, p. 787.)

elevation, so as to be widely separated from the ears (which are rather small) instead of being overlapped by them.

The horns themselves are of a more massive and less elongated type than those of *O. poli*, and also markedly distinct from those of the variety *O. p. karelini*, of the western Thian-Shan, in which the front outer angle is, at least frequently, bevelled off. On the other hand, they are less massive and considerably more open than those of *O. ammon*, and therefore very much more so than in the Tibetan *O. a. hodgsoni*. In *O. ammon* the surface next the face tends to look upwards, whereas in the present form its tendency is to look downwards. A more easily recognized difference is that in *O. ammon* the horns are greatly "nipped in" just below the eyes, in consequence of which the transverse diameter across the eyes is very much less than it is higher up. In the present form, on the contrary, the horns are actually wider across at the level of the eyes than they are at the line of the crown of the head.

Such a "nipping in" is not apparent in *O. ammon hodgsoni*, in which the surface next the face is nearly vertical; and much the same is the case with the Sheep from the Saiar (or Jair) Mountains I have named *O. sairensis*[1]. In fact the Sheep under consideration appears to bear somewhat the same relationship to *O. sairensis*, so far as the curve of the horns is concerned, as is presented by *O. ammon* to *O. a. hodgsoni*, although the extreme openness and basal elevation of the spiral are unique. There are other differences (especially as regards the wrinkles) of the horns of the Ili Argali from those of the Siberian *O. ammon*, sufficiently apparent when the specimens are seen side by side, but almost impossible to describe.

With *O. sairensis* (Pl. VII. fig. 2) the head of the Ili Wild Sheep agrees very closely in general coloration, both forms having the forehead dark and the muzzle white; the white being, however, somewhat purer in the latter. The same type of face-coloration was presented at the time of its death by an Argali from the Altai or Thian-Shan, recently living in the Society's Menagerie, and figured when quite young (at which time the face was wholly dark) by the Secretary[2] as *O. ammon*. As I have elsewhere remarked[3], that specimen differed from the typical *ammon* by the presence of a large white ruff on the chest; such a white ruff being also present in the winter coat of the Ili Sheep. As the Society's Argali was nearly full-grown at the time of its death, it appears to me very unlikely that it would ever have developed a uniformly whity-brown face (especially as *O. sairensis* has the face parti-coloured in youth as well as in the adult); and I am therefore inclined to think that it belonged to some form of the last-named species.

The Ili Sheep is a considerably larger animal than the typical *O. sairensis*, but (if colour be any clue to affinity) seems to come nearer to that species than to any of the named forms which can

[1] 'Wild Oxen, Sheep, and Goats,' p. 185 (1898).
[2] Proc. Zool. Soc. 1899, pl. viii.
[3] 'Great and Small Game of Europe, &c.,' p. 124 (1901).

be identified with certainty. I accordingly propose to regard it as a local race of that species, with the title of *O. sairensis littledalei*. The white muzzle and dark forehead serve to distinguish *O. sairensis* from both *O. poli* and *O. ammon*; and the typical Saiar race of the former species may be differentiated from the Ili race by its inferior size and the much closer spiral formed by the horns. I have elsewhere suggested that *O. sairensis* should be known in English as Littledale's Sheep; and the two races of the species may be severally distinguished as Littledale's Saiar Sheep and Littledale's Ili Sheep.

The description of a new subspecies is of but little interest unless some deduction can be drawn with regard to the habits or distribution of the group to which it belongs. In this case something of this nature can, I think, be suggested. A glance at the map of Central Asia will show that the Saiar and Ili Sheep occur approximately on the same great line of watershed; and that to the south-west *O. poli karelini*, of the western Thian-Shan, comes in on the same line, and thus continues the chain to the Pamirs, the home of the typical *O. poli*. Now all these four types of Sheep have horns with a longer spiral than that of *O. ammon* and its races, and their habitat appears to form a kind of wedge driven into that of the latter group. It is further noteworthy that among the Argalis the length and openness of the horn-spiral decrease from west to east, as exemplified by the occurrence of *O. poli* on the western and *O. ammon hodgsoni* on the eastern frontiers of the group. Nor is this all, for in the three species *O. poli*, *O. ammon*, and *O. sairensis*, the further east or the further south they go it is noticeable that the less open becomes the spiral of the horns. This is apparent when we compare *O. poli* with *O. p. karelini*, *O. ammon* with *O. a. jubata* and *O. a. hodgsoni*, and *O. sairensis* with *O. s. littledalei*. What may be the reason for this feature, I am unable to conjecture.

Admitting that the three species of Argali just mentioned are very closely allied, the question may be legitimately asked, why they and their subspecies are not all classed as phases of a single species, as is done in the case of the Wild Goats of the same region. To this it may be replied, that if such a course were adopted it would be necessary to employ quadrinomialism, in order to express adequately the mutual relationships of the forms here regarded as local races of the three species mentioned.

I may add that I have been told by more than one sportsman that all the Central Asian Argalis pass more or less completely into one another. Without denying the possibility that such may be the case, it is certain that no such transition is exhibited by the series of specimens in the British Museum.

I will now proceed to deal with a Wild Sheep recently brought by Mr. J. Talbot Clifton from Northern Siberia, at a point distant about 40 miles from the mouth of the Yana River.

The exact locality is the north-west end of the Verkhoyansk Mountains, forming the watershed between the valleys of the Yana and the Lena. The specimen which I exhibit this evening (Plate VIII.) is, I am glad to say, to be presented to the British Museum by Mr. Clifton. It is, I believe, the first example of its kind ever brought to England. There are, indeed, two heads of a white Bighorn Sheep in the possession of Mr. Rothschild (which, by the kindness of their owner, I am likewise enabled to exhibit this evening) said to be of Asiatic origin. These heads were brought by traders through Kamchatka, and in 'Wild Oxen, Sheep, and Goats'[1] I assigned one of them to the Kamchatkan form of Bighorn. Subsequently, however, I obtained evidences that the Kamchatkan Bighorn does not turn white in winter, and accordingly pointed out[2] that the identification was in all probability incorrect. I cannot identify either of these heads with the specimen under consideration.

The Wild Sheep of Northern Siberia appears to have been first described by Severtzoff[3] in 1873, under the name of *Ovis borealis*. His description, which is very brief and by no means satisfactory, is in Russian, but a translation in German was given by the late Prof. Peters[4] in 1876. The description is as follows:—"The specimens of this sheep, which were given by Mr. Schmidt to the Museum of the Academy of Sciences at Moscow, were obtained from the mountains and highlands of the Pjasina [Piasina] and Chatanga districts of Northern Siberia. They seem to me to indicate a form intermediate between *O. nivicola* and *O. argali*, but nearer to the former, from which they are doubtfully specifically distinct, and with which they may be identical. From *O. argali* they differ by their smaller horns, inferior size, and whitish belly."

It was subsequently stated that the locality of the type specimens is the mountains separating the valleys of the Nyjnaya and Tunguska from those of the Pjasina and Chatanga. The Tunguska, it may be well to mention, is a tributary of the Yenesei, but the Pjasina discharges into the Arctic Ocean somewhat east of the Yenesei in about long. 185° east.

The travellers Dr. A. Bunge and Baron E. Toll[5] identify with Severtzoff's *O. borealis*, which is considered inseparable from *O. canadensis*, a sheep found in the Verkhoyansk Mountains, and thence down the valley of the Lena to its mouth.

This sheep is undoubtedly the same as the one obtained by Mr. Talbot Clifton; and if the former be rightly identified with *O. borealis* (as is probably the case), the latter must likewise belong to that form.

The first point to mention is that Mr. Clifton's specimen shows no signs of affinity with the Argalis, but is in every respect a true

[1] Page 224.
[2] 'Great and Small Game of Europe, &c.,' p. 23.
[3] Trans. Soc. Moscow, vol. viii. art. 2, p. 153 (1873).
[4] Monatsber. Ak. Berlin, 1876, p. 180.
[5] See Beiträge Kennt. Russ. Reichs, ser. 3, vol. iii. p. 102 (1887).

Bighorn, perfectly distinct from the Kamchatkan representative of that group.

Compared with the Kamchatkan Bighorn, the Wild Sheep of the Yana is essentially the same type of animal; although its general coloration is decidedly lighter, there is a much greater proportion of white, and the dorsal streak and tail are much darker.

The Kamchatkan Bighorn may be roughly described as a nearly uniform grey-fawn animal, with a comparatively small white rump-patch, a certain amount of white on the muzzle, postero-internal sides of limbs, and under-parts, and a brown tail, which is remarakably short and broad. In the male of the Yana Sheep the white rump-patch is much larger, although it does not include the short and bushy tail, or extend on the buttocks above its line of origin. The face, too, is white, with the exception of a wood-brown transverse band midway between the nostrils and the eyes, which expands out to include each cheek. The whole nape is also white mingled with grey. An indistinct dark line runs down the back and becomes more distinct as it approaches the tail, which is blackish brown. There is also a larger proportion of white on the legs and under-parts. An important difference from *O. nivicola* is to be found in the markedly larger ears, which are very thickly haired.

A female head, brought by Mr. Clifton, is wholly greyish white, passing into pure white on the forehead and muzzle.

The skull presents all the features distinctive of that of the Kamchatkan Bighorn.

There can, I think, be no question but that the Yana Sheep is nothing more than a local race of the Kamchatkan Bighorn. And, although these two animals differ more from all the American Bighorns than do the latter from one another, I am of opinion that it is advisable to regard the whole group as local phases of a single variable type. If this view be accepted, the scientific name of the Siberian Bighorn will be *Ovis canadensis borealis*. So far as I know, no English name has been suggested for this sheep, which, I think, may be colloquially designated Clifton's Bighorn.

EXPLANATION OF THE PLATES.

Plate VII.

Fig. 1. Head of Littledale's Ili Sheep (*Ovis sairensis littledalei*), from the type specimen in the British Museum.

2. Head of Littledale's Saiar Sheep (*Ovis sairensis*), from the type specimen in the British Museum.

Both figures one-fourth nat. size.

Plate VIII.

Clifton's Bighorn (*Ovis canadensis borealis*), from the ram brought by Mr. J. Talbot Clifton from the Yana Valley.

2. Remarks on certain Differences in the Skulls of Dicynodonts, apparently due to Sex. By R. Broom, M.D., B.Sc., C.M.Z.S.

[Received April 11, 1902.]

(Text-figure 16.)

In classifying the Dicynodont skulls from the Karroo deposits of S. Africa, one is at once met by the difficulty that scarcely two of them seem to agree in all respects. Even in a series of skulls from one stratum and one locality, and where the presumption is that a number at least must belong to the same species, the differences are such that one might readily incline to make each skull the type of a distinct species. Owen, in his 'Catalogue of S. African Reptiles,' describes 36 specimens of Dicynodont skulls, and these, he believes, represent 32 different species. Lydekker, in his British Museum Catalogue, recognizes among Owen's specimens only 18 good species and 4 which are doubtful.

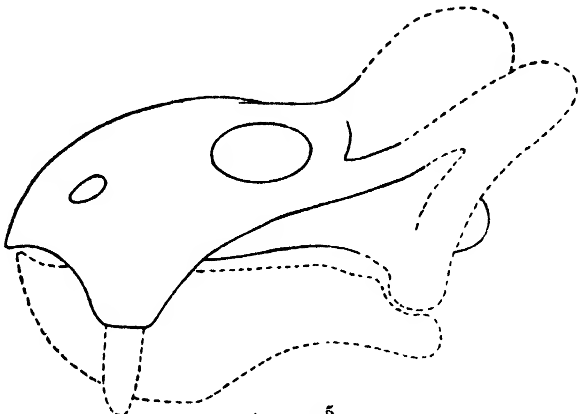
Though the difficulty in classifying Dicynodont skulls is to some extent due to the different ways in which specimens are crushed and to the imperfection of the specimens, it is mainly owing to our ignorance of the changes which may be produced by age and to the differences due to sex. Small Dicynodont skulls are found not more than 3 inches in length with well-developed tusks and well-ossified bones, which in their general characters resemble some of the largest skulls that have been discovered. Until a much greater number of specimens has been found, it will be impossible to decide definitely whether many of the small skulls are those of small species or of the young of the larger kinds. With regard to the differences due to sex, I have come across a few skulls which seem to give us some help.

In Port Elizabeth there is a Dicynodont skull in the collection of the Eastern Province Naturalists' Society, which differs very markedly from any previously described; and this I have described[1] as the type of a new species, *D. latifrons*. In the Gill College, Somerset East, is a large skull which I believe belongs to the same species, but which differs very strikingly from the Port Elizabeth specimen in the structure of the maxillaries and tusks. Both the skulls are from Burghersdorp, and agree in the following features:—The nasal region is very greatly developed and has a prominent median ridge; the frontal region is flat and exceedingly broad, causing the orbits to look directly outwards; the parietal crest rises sharply up from the frontal plane, making an angle of about 120° with it. In the Port Elizabeth specimen the tusk is feeble and is directed forwards almost in a line with the malar arch. Along the lower margin of the maxillary there passes backwards from near the root of the tusk a well-marked

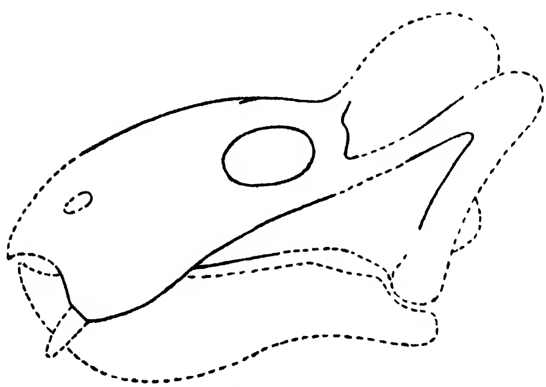
[1] R. Broom, "On two new Species of Dicynodonts," Ann. S. Afr. Mus. vol. i. pt. 3, 1899, p. 452.

bony ridge, which is directed outwards and slightly downwards. In the Gill College specimen the tusk is very powerfully developed and is directed mainly downwards, and in connection with the great development of the tusk the maxillary is a very massive

Text-fig. 16.



A. $\times \frac{5}{26}$



B. $\times \frac{3}{13}$

Outline views of skulls of *Dicynodon latifrons*: (A) male and (B) female.

bone. Instead of the bony ridge seen in the Port Elizabeth specimen, we have here, in a similar situation, a great thickening of bone forming a tuberosity more than twice the width of the ridge in the other specimen.

As the two specimens are from the same locality and agree closely in most of their characteristic features, it seems reasonable to conclude that the differences in the maxillary development are due to sex; the male having the powerful tusk directed downwards, and the female the small tusk which is directed more forwards.

The accompanying drawings (text-figs. 16 A & 16 B, p. 87) delineate side views of the two specimens, partly restored. In the male the lower jaw has been restored from the jaw of *D. leoniceps*.

That the differences are due to sex receives confirmation from the skulls of other forms.

The type of Owen's *Dicynodon tigriceps* is a skull with a very powerful downwardly directed tusk. Near Pearston I have discovered a skull which, though imperfect, agrees closely with *D. tigriceps* in its posterior region, but the tusk is so inconspicuous that at first one would think the skull belonged to a species of *Udenodon*. As in the female *D. latifrons*, the tusk is directed as much forwards as downwards, and has a diameter of only half that of the tusk of the male (Owen's type), though the skull is even a little larger in the female specimen.

In *Udenodon*-skulls we find similar differences in the maxillary development— skulls with powerful downwardly-directed caniniform ridges, and skulls with feeble, flattened, forwardly directed maxillary processes. Owen's type of *Udenodon baini* is a good example of what I believe to be a male skull. The little skull which I have recently figured as the type of *U. gracilis*[1] is probably a fairly typical female skull. I have in my possession a skull which I believe to be that of *U. baini*, but which has a feeble maxillary very much resembling that in the type of *U. gracilis*. If it is not the female of *U. baini*, it must be of a new species; and as the differences in maxillary development are closely comparable to those seen in the two types of *Dicynodon*-skulls, one feels justified in concluding that the specimens with the feeble maxillæ are females.

Besides the differences in maxillary development, it is probable that when more perfect specimens are found a number of additional correlated characters will be discovered. The arches, so far as preserved, are undoubtedly more feeble in the female *Dicynodon latifrons*, and it is probable that the squamosal will be found to be less greatly developed than in the male. It is also highly probable that the lower jaw in the female is less massive than in the male.

[1] R. Broom, "On the Structure and Affinities of *Udenodon*," Proc. Zool. Soc. 1901, vol. ii. p. 162.

3. A Note upon the Gonad Ducts and Nephridia of Earthworms of the Genus *Eudrilus*. By Frank E. Beddard, M.A., F.R.S., Vice-Secretary and Prosector of the Society.

[Received April 14, 1902.]

(Text-figures 17–20.)

(1) *Oviduct.*

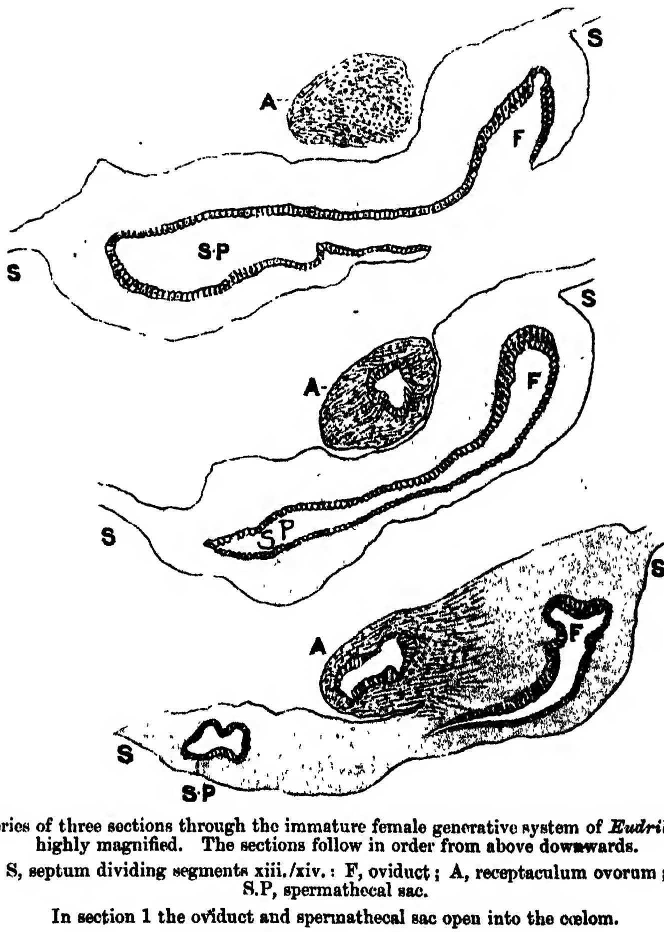
Although a considerable number of memoirs have been published which deal entirely or in part with the female reproductive organs of *Eudrilus*, I am able in the present communication to add some new facts to what has been already ascertained. The original describer of the genus and of the organs in question was Perrier, whose account and figures are partly correct, though he mistook for the ovary the homologue of the receptaculum ovorum, or egg-sac as it is simpler to call this cavity which lodges the developing ova[1]. Later the structure of these organs was more correctly described by myself, the continuity of the sac containing ripe and developing ova with the undoubted oviduct being demonstrated; by Perrier the sac had been figured as attached to the wall of the spermathecal sac just at the point where the oviduct, termed by him "un tube ... entortillé," and not identified as the oviduct, opens[2]. This was confirmed later by Dr. Horst, who added some details[3]. Neither Dr. Horst nor I saw the real ovaries in any of the specimens which we examined. Shortly after I found in the xiiith segment of some examples of the genus from British Guiana, a pair of cellular bodies lying in the usual position that is occupied by ovaries, and wrapped in a small sac which I found to open into the duct of the spermathecal sac[4]. Dr. Horst's investigations finally settled the matter, and proved conclusively that the cellular bodies in the xiith segment of *Eudrilus* are ovaries[5]. I thought, however, that this genus possessed two pairs of ovaries, those of the xiiith segment, and a pair in the xivth which have become involved in the egg-sac. This view is also taken by Eisen, who has made the latest contribution to the subject, and whose figure of the female reproductive system in this annelid is the best with which I am acquainted[6].

I believe that we are now, owing to these various memoirs, in possession of accurate information concerning the organs in question in the sexually mature *Eudrilus*. But there is not at present any certainty as to the correspondence of the several parts of the complicated apparatus with corresponding regions in the equally complicated female organs of the other Eudrilidæ.

[1] Nouv. Arch. du Muséum, viii. (1872) p. 71.
[2] Zool. Anzeig. 1886, no. 224; Proc. Roy. Soc. Edin. xiii. (1885–86) p. 672.
[3] Notes from the Leyden Museum, ix. p. 247.
[4] Zool. Anzeig. 1888, no. 293; P. Z. S. 1887, p. 372.
[5] Mém. Soc. Zool. France, iii. (1890) p. 223.
[6] Proc. Calif. Acad. Sci. ii. (3) 1900, p. 135.

Indeed, the genus *Eudrilus* at present seems to be rather exceptional in the structure of these organs. No one, so far as I am aware, has traced out the development of the various ducts and pouches of the generative organs, by which alone a clear idea of the homologies of those parts can be acquired. It is this part of the subject to which I desire to draw attention in the present communication. I have studied three series of longitudinal

Text-fig. 17.



Series of three sections through the immature female generative system of *Eudrilus*, highly magnified. The sections follow in order from above downwards.

S, septum dividing segments xiii./xiv.: F, oviduct; A, receptaculum ovorum; S.P, spermathecal sac.

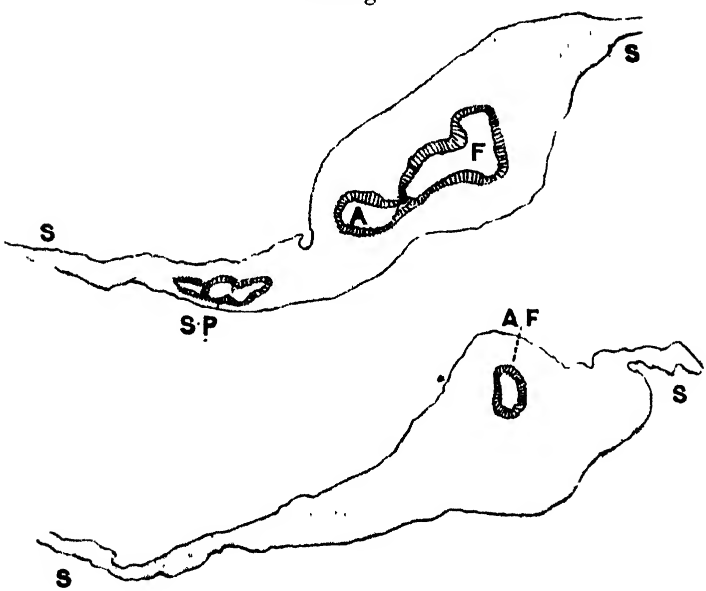
In section 1 the oviduct and spermathecal sac open into the cœlom.

sections through the generative region of immature and quite small examples of a species of the genus *Eudrilus*, which, on account of their immaturity, I have been unable to identify. So

far as the anatomical characters allow me to guess, the species does not seem to be at all different from *Eudrilus eugeniæ*.

Both Drs. Horst and Eisen, as well as myself, have stated, or at least assumed, that the spermathecal sac of *Eudrilus* opens on to the exterior by the laterally placed and paired orifices upon segment xiv., and that the oviducts open each one of them into the spermathecal sac some little way in front of the external pore of the latter. This idea is illustrated in a graphic form by Eisen, who colours the spermathecal sac blue and the oviduct pink; he also speaks of the oviduct as opening into the spermathecal sac. This idea, which has been thus generally accepted, is nevertheless totally wrong[1]. In the youngest example of this worm which I

Text-fig. 18.



Continuation of the series represented in text-fig. 17. Lettering as before. In section 1 the branch from the receptaculum (A) has nearly joined the oviduct (F); in section 2 they are completely fused.

have had the opportunity of studying, the septum dividing segments xiii./xiv. was thickened considerably in the region which is occupied by the female efferent system. There were no pores upon the exterior of segment xiv. in the place where those exceedingly conspicuous orifices are to be seen in the mature worm. But a careful scrutiny of the sections (text-figs. 17 & 18) in order,

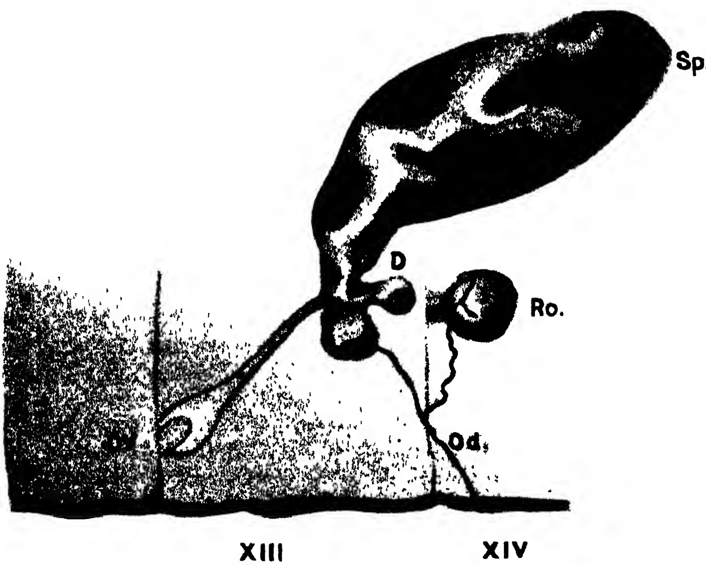
[1] It may be pointed out, however, that Dr. Horst letters the combined duct which leads from the oviduct and spermathecal sac to the exterior "ov.," which, in the explanation of the lettering, is stated to signify oviduct. See *loc. cit.* Mém. Soc. Zool. France, pl. viii. fig. 14.

shows that a tube of feeble dimensions and with a thick muscular coating nearly reaches the exterior at a point not far off the lateral setæ of that segment. This tube actually perforates the body-wall for a certain (short) distance, and is undoubtedly the tube which afterwards opens at the same spot, and has been regarded as the narrower, distal, part of the spermathecal sac. Traced in the opposite direction, this tube approaches the thickened septum which separates segments xiv./xiii. It enters into the thickness of that septum and traverses it obliquely and dorsally in direction. At or about the middle of the septum the tube gives off a branch, or is joined by another tube, which also passes obliquely through the septum and in a short straight course. The direction is, however, back again towards the lumen of segment xiv. This second tube ends in a smallish rounded body, whose interior is divided up by trabeculæ, and which is plainly the receptaculum ovorum or egg-sac. It seems to be clear, therefore, that the two tubes together constitute the oviduct of the mature worm which, as is well known, opens into the egg-sac. But in this case, we should have the anomaly of the oviduct being connected with the egg-sac alone, as indeed Eisen states to be the case in the sexually mature worm. The anomaly, however, does not exist. The two tubes that we have been just considering open almost immediately, after their junction the one with the other, into the cavity of the xiiith segment in common with a sac which extends dorsally, as well as ventrally, for a short distance. It might be said, indeed, that the mouth of the two tubes is rather into the sac, which then, in its turn, opens into the cœlom of segment xiii. At the point of opening, the columnar epithelium lining the tube becomes more pronounced, and this region may be looked upon as the funnel of the oviduct. In fact, we have in the immature worm an oviduct which opens into the xiiith segment on the one hand, and on to the exterior on the other, a branch being given off to the egg-sac on the way from the internal to the external orifice. The genus *Eudrilus*, therefore, is not exceptional among Eudrilidæ; the oviduct, as in at least many genera [1], communicates with the exterior by a pore on the xivth segment quite independently of the spermathecal sac; at the other end it divides into two tubes, one of which opens by a funnel into the egg-sac, the other by another funnel into a part of the system of sacs involving the ovary. This statement of course refers to the adult worm, in which the spermathecal sac is closed from the body-cavity. The spermathecal sac therefore of this genus is, as in other Eudrilidæ, a part of the egg-conducting apparatus, here simpler than elsewhere. The spermathecal sac has no orifice of its own to the exterior: it merely opens indirectly through the medium of the oviduct, just as do the sacs involving the ovaries in the genus *Stuhlmannia* [2]. But in the last-mentioned genus there is, in addition, an entirely independent orifice of the system of egg-

[1] See Beddard, P. Z. S. 1901, vol. i. p. 354.
[2] Beddard, *loc. cit.*

conducting sacs on to the exterior by a median unpaired pore. Of this there is no trace in *Eudrilus*, which therefore, so far, is more closely allied to *Nemertodrilus* than to any other form whose anatomy has been adequately studied. But in *Nemertodrilus* the large sac, which is clearly equivalent to the spermathecal sac of *Eudrilus* and other genera, is permanently open into the cavity of segment xiii. This represents an immature condition such as is transitory in *Eudrilus*.

Text-fig. 19.



Diagrammatic representation of female reproductive system of *Eudrilus*.

D, gland appended to spermathecal sac; *Od.*, oviduct; *Or.*, ovary, *Ro.*, receptaculum ovorum; *Sp.*, spermathecal sac.

The accompanying diagram (text-fig. 19) will therefore represent more accurately than the hitherto published figures the distinctions between the different regions of the egg-conducting apparatus in *Eudrilus*. There are two other points with which I wish to deal before leaving the female efferent apparatus. In the first place, I have found in these immature worms no trace of the "oviducal gland" attached to and opening into the spermatheca in adult examples of the worm. The second matter has to do with the ovaries and the sacs in which they are enwrapped. It is noteworthy that in these young worms the ovary was many times larger than the testes; and that, while the latter showed no developing sperm in their neighbourhood or in the sperm-sacs, the cells of the ovary contained some very large and nearly fully

developed ova. It appears to me that this dichogamy, resulting in the earlier maturation of the female gonad, has a relation with the complicated condition of the efferent apparatus. I have on former occasions dwelt upon the difficulty of the transit of the eggs into the egg-sac of the xivth sagment, and used that difficulty as an argument in favour of regarding the egg-sac as really representing a second ovary which has become involved by the sac. This view I abandon so far as concerns *Eudrilus*; for in the young stages, when the egg-sac is empty of eggs, there is no trace of any ovary in the segment which contains it. In the adult worm, the tract of oviduct which lies between the egg-sac and the junction of the oviduct with the branch that opens into the egg-conducting apparatus is long and much convoluted. This is well shown in Eisen's figure referred to.

In the immature worm the transit would be comparatively short and not hampered, moreover, by any ciliary action. This consideration, coupled with the early development of the female sexual cells, appears to me to have some significance. The ovaries in the most immature worm which I have examined were enclosed in a sac arising from the septum lying between the xiith and xiiith segments. This sac was apparently completely closed. In slightly more mature stages the sac of one side was prolonged into the short tube which I, Dr. Horst, and Dr. Eisen have described in the adult worm. I ascertained that this egg-tube opened into the spermathecal sac; but, in addition to this, the tube gave off a branch which crossed the body-cavity above the ventral blood-vessel, and opened into the spermathecal sac of the opposite side of the body. The ovary of that side was enclosed in the usual sac, which was not prolonged into an egg-tube. This state of affairs, whether normal in the species, or only occasionally to be met with, recalls the more usual characteristic of the Eudrilidæ. In other genera, for example in *Heliodrilus*[1], the same communication between the ovary and both spermathecal sacs occurs by a slender tube crossing over the nervous system and ventral blood-vessel.

(2) *Sperm-ducts.*

The anatomy of the male efferent organs in the adult *Eudrilus* has been also fully described by the authors quoted above. But here, again, nothing up to the present time is known of the condition of the various parts of this system in the immature worm. I find that the spermiducal glands are in the form of a single tube, with no division of the lumen such as exists in the glandular tube of the sexually mature individual. It seems, therefore, that the double spermiducal gland of the adult is not formed by the fusion of two distinct tubes, but that the division is secondary. There is naturally no terminal sac into which this

[1] Quart. Journ. Micr. Sci. xxxii. (n. s.) pl. xix. fig. 41.

opens, nor any trace of the penis or of the cushion-like pad on to which opens the duct of the "U-shaped tube." The latter, which is distinctly composed of two tubes, opens after the two tubes have united into the terminal section of the spermiducal gland just before the opening of the latter on to the exterior.

I may finally observe, with regard to the spermiducal glands, that the duct of the nephridium opens in common with the duct of that gland, as is also the case with *Heliodrilus*[1].

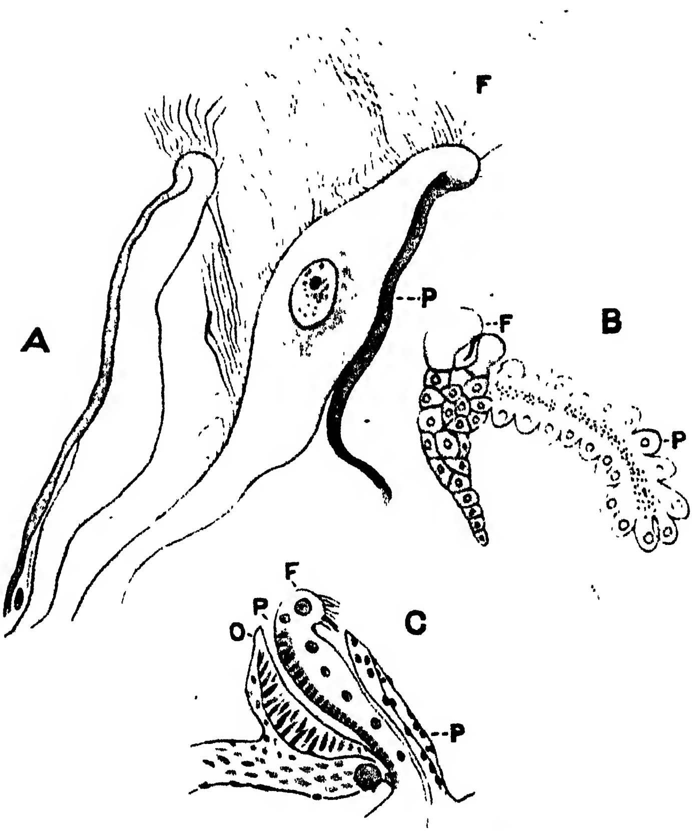
(3) *Nephridia of Genital Segments.*

I do not think that it has been pointed out that the nephridia of *Eudrilus* are imperfect in the xith, xiith and xivth segments. The nephridia of those segments have no funnel opening into the segment in front. It is of course proverbially difficult to prove a negative. But, in this case, the funnels when present are so extremely conspicuous, that it is not easy to understand how they can have been missed if really present in the segments where I believe them to be deficient. Moreover, the funnel when present is sufficiently large to appear in four, or even five consecutive sections. In no instance—and I have carefully examined both sides of the body of three examples—was there the faintest trace of anything that could be put down to even the degenerate rudiment of a funnel. The persistence or non-persistence of nephridial funnels in those segments which contain the funnels of the gonad-ducts has not been much enquired into; so far, at least, as concerns the terrestrial Oligochæta. In the majority of the aquatic forms the entire nephridium of the segments concerned vanishes on the appearance of the gonad-ducts. I published some years since[2] several reasons for believing that in *Octochætus multiporus* the funnels of the nephridia belonging to the genital segments were actually converted into the gonad-duct funnels. On theoretical grounds only my contention has been questioned by Mr. Goodrich[3]. In his opinion, and to this view Prof. Lankester has given in his adhesion[4], there can be no connection between the funnels of the two kinds of tubes, inasmuch as the gonad-funnels are morphologically different from the nephridial funnels, being the internal apertures of the "cœlomo-ducts." That cœlomo-ducts quite distinct from nephridia exist in the Oligochæta I fully believe; but I am not convinced that they are the oviducts and sperm-ducts. As real cœlomo-ducts I reckon the pores upon the xiiith segment in *Nemertodrilus*, the "spermathecal sac" and its external orifice in *Lybiodrilus*, and a variety of similar structures which are in effect ducts leading from the cœlom to the exterior. Nor can there be any possible confusion between such structures and nephridia. It may be readily admitted that

[1] *Loc. cit.* pl. xix. fig. 40.
[2] Quart. Journ. Micr. Sci. xxxiii. (n. s.) p. 495.
[3] *Op. cit.* xxxvii. (n. s.) p. 491.
[4] A Treatise on Zoology: edited by E. Ray Lankester, part ii. p. 13.

the absence of nephridial funnels and the presence of gonad-duct funnels, in segments x., xi., xiii., does not of itself prove that the former have been converted into the latter. But the facts are

Text-fig. 20.



A, nephridial funnel of *Branchiobdella* (after Moore).
F, funnel-cell; P, peritoneal cell.

B, developing nephridium of *Rhynchelmis* (after Vejdovsky).
F, funnel; P, vesicular region of nephridial cells.

C, funnel and subducal funnel of *Allolobophora* (after R. E. Bergh).
F, nephridial funnel; P, peritoneum; O, sperm-duct funnel.

not at variance with such an assumption. Bergh and Lehmann have both pointed out that the nephridial funnels of *Lumbricus* (*sensu lato*) persist for a longer or shorter time in the segments

into which the funnels of the gonad-ducts open. This fact appears at first sight to be fatal to my hypothesis. I am not, however, convinced that it is necessarily so. In Dr. Bergh's figure[1] illustrating the first origin of the funnel (text-fig. 20, C, p. 96), it will be noticed that this sperm-duct funnel originates as a thickening of the peritoneal covering of the nephridial funnel. Here it may be urged that the peritoneal covering of the nephridium is not the funnel itself, but a layer simply enwrapping it, and not related to it any more than is the peritoneal covering of the kidney in a vertebrate to be looked upon as a part of the kidney itself. It may be pointed out, however, that what is called "peritoneum" in these Annelids is apparently not quite to be compared to the cellular lining of the cœlom in a vertebrate in every case. For example, in *Rhynchelmis* Vejdovsky has shown[2] (text-fig. 20, B, p. 96) that the vesicular cells involving the nephridium are derivatives of the actual nephridium itself, and not of any peritoneal covering. The nephridium, in fact, is not covered by a layer independent of itself. An even more striking fact is afforded by the condition of the nephridial funnel in the Discodrilid *Branchiobdella*. In a species of this genus, Mr. J. P. Moore[3] has figured (text-fig. 20, A, p. 96) an absolute continuity between the cells of the small funnel of that worm and a long thin cell enveloping the funnel outside and thus presenting the appearance of a peritoneal layer. Mr. Moore has remarked not only upon the "direct continuity" of these cells, but also upon the resemblance of the nucleus of this "peritoneal" cell to those of the funnel-cells which "is very striking." It appears to me that these various considerations show that it is at least premature to regard the gonad-funnels of the Oligochæta as essentially different from the nephridial funnels. None of the facts which I have called attention to here are at variance with the older view of the intimate connection between nephridia and genital ducts in the Oligochæta[4].

[1] Zeitschr. f. wiss. Zool. xliv. pl. xxi. fig. 19.

[2] Entwickelungsgeschichtliche Untersuchungen, 1888–92, pl. xxvi. figs. 11, 12, 13.

[3] Journ. Morph. xiii. pl. xxi. fig. 10.

[4] The connection between the gonad-funnels and the nephridial funnels may be indeed not without analogy to the connection between certain cartilages in the vertebrate skeleton with subsequent ossifications. The line between membrane-bone and cartilage-bone is not always plain and easy to draw, and there are cases where a bone originally formed in cartilage comes to be later a product in part or entirely of membrane independent of the cartilage. A condition of apparently total independence is thus produced, which masks the real connection. This is possibly the case with the bones investing the palato-pterygoid arch in the higher vertebrates. And other instances might be quoted from this and other organs and systems.

4. On the Marine Spiders of the Genus *Desis*, with Description of a new Species. By R. I. Pocock, F.Z.S.

[Received May 22, 1902.]

(Text-figure 21.)

In this paper an attempt has been made to collect what is known of the habits of the marine or, more strictly speaking, littoral Spiders belonging to the genus *Desis*. It has been impossible to give a full account of the specific characters of all the known forms, since only four out of the seven described species are actually known to me. For the remainder I have been dependent upon the figures and descriptions published by other authors.

I have already pointed out (Ann. Mag. Nat. Hist. (6) xvi. p. 143, 1895) the identity between the so-called genera *Desis*, *Dandridgia*, and *Robsonia*, and Simon has subsequently and independently confirmed the synonymy of *Desis* and *Robsonia* (Hist. Nat. Araign. ii. p. 228, 1898). The genus *Paradesis* was instituted for the reception of the two S. African species of the same group, which differed from the species recorded up to that time from the Indo- and Austro-Malayan and New Zealand seas in the wider spacing of the eyes and the weak spine-armature of the legs—characters which, taken in conjunction with the geographical distribution of the two sets of species, appeared a sufficient basis for the establishment of the genus *Paradesis*.

A few months ago, however, the British Museum received from Miss Kenyon a specimen of a marine spider which was discovered on the coast of Victoria, in Australia. Curiously enough, this spider in the spacing of its eyes approximates to the South African species; and in the spine-armature of its posterior legs is also more nearly allied to the latter than to the known New Zealand and Austro-Malayan forms.

Since, therefore, no reasons based upon geographical grounds can now be alleged in support of the genus, I propose to drop *Paradesis* as a synonym of *Desis*, on the supposition that additional intermediate forms between the two types will in all probability be discovered in the Australian seas, and also because, so far as the spine-armature of the legs is concerned, the two South African species appear to differ from each other more than one of them does from the new Australian species.

Genus Desis Walck.

Desis Walckenaer, Ins. Apt. i. p. 610 (1837).
Dandridgia White, Proc. Zool. Soc. 1847, p. 5.
Robsonia O. P. Cambridge, Proc. Zool. Soc. 1879, p. 686.
Paradesis Pocock, Bull. Liverpool Mus. i. p. 75 (1898).

In case it may be found possible and desirable in the future to resuscitate any or all of the above-given generic names, it is

advisable to point out what are the type-species to which these names must remain affixed:—

The type of the genus *Desis* is the species represented by the specimens (? in the Paris Museum) described by Walckenaer as *Desis dysderoides*.

The type of the genus *Dandridgia* is the species represented by the specimen in the British Museum described by White as *Dandridgia dysderoides*.

The type of the genus *Robsonia* is the species represented by the specimen in the Rev. O. P. Cambridge's collection described as *Robsonia marina*.

The type of the genus *Paradesis* is the species represented by the specimen in the British Museum described as *Paradesis tubicola*.

1. Desis martensi L. Koch.

Desis martensi L. Koch, Die Arachn. Austral. p. 347, pl. xxix. figs. 2–29 (1872); T. G. Workman, Malaysian Spiders, no. 11, p. 74 (1896).

Loc. Singapore; Pulo in the Java Sea.

The British Museum has specimens of this species from Singapore (*Major Archer*, *Lieut. Kelsall*, and *P. F. Bedford*).

Lieut. Kelsall's specimens, which were forwarded by Mr. H. N. Ridley in 1890, were accompanied by the following information:— "From the holes bored in the coral rock by a species of *Lithophaga*. From Buran Durat Reef near Blacku Mati Island. Nearest land ½ mile distant. Reef uncovered at half-tide."

The announcement of the discovery by Dr. von Martens that this spider is truly marine elicited the following expression of opinion from Dr. C. L. Koch, to whom the specimens were submitted for description:—"[The spider] was collected by [Dr. von Martens] on coral-reefs at Singapore. . . . . The species is remarkable in that it has established itself in these reefs, which are only temporarily uncovered by the sea. . . . . That the species discovered by Dr. E. von Martens and Dr. Johswick can really, like our indigenous *Argyroneta aquatica* Cl., live under water, is to me doubtful in the highest degree, for it is wanting in the outward visible signs of the breathing apparatus which corresponds to such submarine mode of life, and which has been anatomically demonstrated in *Argyroneta aquatica*[1]. It also speaks against it, that yet another species of spider, an *Attus*, was found on the same coral-reefs, and we may assume with all certainty that this is a true terrestrial form. I opine that these spiders, perhaps in former times, were floated in an accidental manner from the land to these reefs and now live in the holes of the coral-bank, within which they withdraw at the time of flood, and which they close

[1] This is scarcely true, for, as I have pointed out (Ann. & Mag. Nat. Hist. (6) xvi. p. 143), *Desis martensi* has the tracheal slit large and well in advance of the spinners, though not so far forwards as in *A. aquatica*.

against the entrance of the water with a thick web. . . . . When once both sexes had been transferred to the coral-reefs, the species would increase and form a colony there."

Dr. Koch subsequently received the following further information from Dr. von Martens:—"During my residence at Singapore in October 1861, I repeatedly visited a coral-bank in the neighbourhood of New Harbour, of which large tracts were exposed above water during the ebb, at the time of new and full moon. My attention was chiefly directed to Crustacea and Mollusca; I tore off pieces of coral and broke them up to get at the creatures hidden within. To my astonishment, I several times observed spiders hurriedly escaping. The idea occurred to me at first that we ourselves had brought them from the shore in our clothing. . . . . This suspicion was rendered unlikely by the frequent repetition of the event, and was conclusively disproved, as Dr. Johswick found a web of undoubtedly one of these spiders in an old dead mussel-shell between the coral, stretched sheet-like in the cavity of the shell" (C. L. Koch, Die Arach. Austral. pp. 349–350). Dr. Koch had previously discussed the discovery of the marine habits of this Spider.

Mr. T. G. Workman (Malaysian Spiders, pt. 10, p. 74, 1896) writes of this species:—"This spider was discovered by me on the Blacku Mati coral-reef off the New Harbour, Singapore, the place where it was first discovered by Dr. Martens in 1861. I found it was perfectly helpless when placed in a bottle of water, showing in every way that it was not in its natural element. It lives in holes made by a species of *Lithodomus*, and spins a matted web across the hole and so keeping an air-chamber for itself during flood-tide. It is found in considerable numbers, but as it runs with great rapidity, is very hard to catch."

2. Desis maxillosa (Fabr.).

Aranea maxillosa Fabricius, Ent. Syst. ii. p. 411 (1793), teste Schiödte.

Desis dysderoides Walckenaer, Ins. Apt. i. pp. 610 & 682, pl. iv. fig. 151 (1837), also ii. p. 483 (1837); L. Koch, Die Arachn. Austral. p. 347 (1872).

Desis maxillosa Simon, Hist. Nat. Araign. ii. p. 225, figs. 215–217 (1898).

Loc. New Guinea (*Quoy & Gaimard*); Vanikoro (sec. *Simon*); Santa Cruz[1] Island in the Melanesian Archipelago to the north of the New Hebrides (*Fabricius*).

Habits unrecorded. No specimen in British Museum. The characters of this species given below are taken from Simon's figures.

[1] Fabricius gives St. Crux Island (Dr. Pflug) as the locality of this species. This is presumably the Santa Cruz Island in the Melanesian Archipelago. It must be borne in mind, however, that there is an island of St. Croix close to Port Elizabeth in South Africa, which is also the home of *Desis*. Is it not possible therefore that *maxillosa* Fabr. was based upon a South African species?

3. Desis vorax L. Koch.

Desis vorax L. Koch, Die Arachn. Austral. p. 345, pl. xxix. figs. 1–1*f* (1872).

Loc. Upolu, in the Samoa Archipelago.

Habits unrecorded. No specimen in British Museum. The characters given below are taken from L. Koch's figures.

4. Desis marinus (Hector).

Dandridgia dysderoides White, Proc. Zool. Soc. 1849, p. 5 (nec *Desis dysderoides* Walck.).

Argyroneta marina Hector, Tr. N. Zealand Inst. x. p. 300 &c. (1877) (in note to paper by C. H. Robson).

Desis robsoni Powell, Tr. N. Zealand Inst. xi. pp. 263–268, pl. xii. (1879).

Robsonia marina O. P. Cambridge, Proc. Zool. Soc. 1879, p. 686.

Desis marinus Pocock, Ann. Mag. Nat. Hist. (6) xvi. p. 143 (1895).

Loc. New Zealand (Cape Campbell) and E. Australia (Port Jackson); also New Caledonia (sec. *Simon*).

The only specimen the British Museum possesses of this species is the type of *Dandridgia dysderoides* from New Zealand (*Erebus & Terror*). I have, however, examined a specimen of apparently the same species belonging to Mr. H. R. Hogg, F.Z.S., which was taken between tide-marks in Port Jackson. It is probably this species, rather than the one described below as *D. kenyonæ*, that Mr. Whitelegge refers to in the following terms: "There is a very common species of spider found under stones about low-water mark. It appears to be covered with a short pubescence which prevents the salt water from wetting the body." Watson's Bay and Taylor Bay in Port Jackson. (See Journ. R. Soc. N. S. Wales, xxiii. p. 233.)

The original account of this species given by Mr. Robson runs as follows:—

" . . . . . I found a veritable spider [at Cape Campbell] quite at home under the water, and having a nest in an old Lithodomus-hole, of which the rocks are full. All the spiders of this kind which we have found have had nests in these holes, and always under water at all times of the tide. Over the mouth of the hole the spider spins a close web, which when finished looks like a thin film of isinglass and is water-proof; and behind the film is the nest and egg-sac, which last is of various shapes and contains a large number of eggs. When the spider is disturbed, it goes to the bottom of the pool, and if a small stick or straw is extended to it it at once gets ready for a fight, advancing its long and powerful mandibles for that purpose. When a small fish is placed in a bottle of water with one of these spiders, the latter will attack it at once, driving its long sharp falces into the fish near the head and killing it instantly. Each spider seems to live in

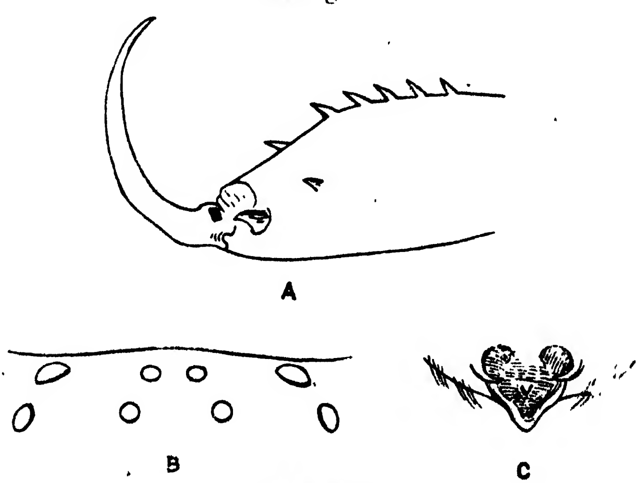
a solitary state, and it is, I believe, an exceedingly pugnacious little animal . . . . "

Mr. Robson subsequently supplied Dr. Powell with the following additional observations:—"The nests of this spider do not, in my opinion, occur below low water; but it is difficult to state positively. The mouth of the Lithodomus-hole in which the nest is made is often, if not always, under low water in a tidal pool, and the nest is only to be got at by breaking up the rock with a heavy hammer The spider when going to the bottom of the pool, on being disturbed, does not take down an air-bubble so far as I could see, and is able to live a considerable time without air or only the small amount to be found in sea-water. I have kept them alive for several days in a bottle quite full [of water]. The cocoons of eggs are found at the end of the hole and always quite dry. I have not seen these spiders at any place but Cape Campbell, and then not far above low-water mark, there being many feet of water over the rocks in which they live at high tide.'

5. Desis kenyonæ, sp. n. (Text-fig. 21.)

Colour normal; carapace and mandible yellowish red; legs and abdomen olive-yellow, sternum more uniformly testaceous than the carapace, the scopula on the protarsi of 2nd, 3rd, and 4th legs showing as dusky patches.

Text-fig. 21.



Desis kenyonæ.

A, lower side of the left mandible, to show the arrangement of the teeth.
B, eyes viewed from above, the anterior edge of the carapace uppermost.
C, vulva.

Carapace low, a little longer than tibia of 1st leg and also longer than the patella and tibia of 4th.

Eyes (text-fig. 21, B) of posterior line slightly recurved, widely separated, the laterals a little further from the medians than the medians are from each other; medians considerably smaller than laterals, about four diameters apart and about five diameters from the laterals; laterals on each side subequal, about a diameter apart; anterior median eyes barely a diameter apart, at least three diameters from the anterior laterals; ocular quadrangle about one-third wider behind than in front, the anterior median eyes a little nearer to each other than either is to the corresponding lateral; distance between anterior and posterior median about one-third of the distance between anterior median and anterior lateral, and one-fourth of that between posterior median and posterior lateral.

Mandibles (text-fig. 21, A) normal in size and direction; fang-groove armed behind with two teeth, the distal much the largest, the proximal separated from it by a space which is equal to about four times its own length; anterior border of fang-groove armed with 6-7 teeth, the distal near the base of the fang opposite the interval between the two teeth of the posterior row, the remaining 5 or 6 remote from it, evenly spaced, the distal of the series rising well behind the proximal tooth of the posterior row.

Legs: 1st pair unspined, 2nd leg with three inferior protarsal spines, one apical and two submedian; tibia of 3rd and 4th with a pair of inferior apical spines; protarsi with two or three spines at the base of the scopula and three at the apex, one median and one on each side; tarsi also with a few spiniform bristles intermixed with the normal bristles.

Vulva (text-fig. 21, C) as in the other species, consisting of a horny plate impressed with a heart-shaped pit which is wider than long, marked posteriorly by a low median crest and bordered by an upstanding edge which is posteriorly produced into an angular process with rounded apex, and armed on each side with a slender pointed process directed downwards and backwards.

Measurements in mm.—Total length 11, carapace 5; 1st leg 18, 2nd leg 13, 3rd leg 10·5, 4th leg 13.

Loc. Australia: San Remo, Westernport Bay in Victoria (*Miss Kenyon*).

Perhaps belonging to this species were the specimens recorded from Port Jackson by Mr. Whitelegge, J. R. Soc. N.S.W. xviii. pp. 162–323 (*cf. supra*, p. 101).

Concerning the habits of this spider, Miss Kenyon, to whom I have great pleasure in dedicating the species, writes:—"During a recent stay at San Remo, while turning over stones at low-water in search of Mollusca, I noticed what seemed to be the sea-worn shell of a *Crepidula*. Upon detaching the shell from the partially submerged rock to which it adhered, I found underneath it the spider with its legs drawn backwards and its head concealed under a sheet of web which exactly resembled the septum of the valve of a *Crepidula*, although the shell itself was that of an *Anomia*. The spider was conspicuous from the intense

blue of its abdomen and the vivid red of its cephalothorax. The shell was apparently fixed to the ground by means of a silken attachment, since the shell had to be removed by the insertion of the point of a penknife."

6. Desis formidabilis O. P. Cambridge.

Robsonia formidabilis O. P. Cambridge, Proc. Zool. Soc. 1890, p. 625, pl. liii. fig. 5.

Paradesis formidabilis Pocock, Bull. Liverpool Mus. i. p. 77 (1898).

S. Africa.

Habits unrecorded. No specimen in British Museum.

Unfortunately the arrangement of the teeth on the mandible in this species is neither figured nor described. The alleged absence of spines from the legs compels the conclusion that this species is distinct from the following *D. tubicola*. In the subjoined table of species, having no other characters to lay hold of, I have had no choice but to use this absence of spines in contrasting the two forms—an arrangement which unfortunately suggests that the relationship between the two South African species is less than that between one of the latter and the Australian species *D. kenyonæ*. On *à priori* grounds this is hardly likely to be the case.

7. Desis tubicola (Pocock).

Paradesis tubicola Pocock, Bull. Liverpool Mus. i. pp. 76–77, figs. 1–3 (1898).

Loc. S. Africa; Wynberg in Cape Colony (*N. Abraham*).

Mr. Nendick Abraham's account of the habits of this spider is reprinted from the 'Bulletin of the Liverpool Museum.' After describing his first discovery of the animal in the tube-masses of *Tubicola*, the writer proceeds:—"This formation [the *Tubicola*-masses] is invariably covered by the sea at high tide, and much of it even at low tide . . . . Sometimes I have found five or six spiders in one piece of material weighing five or six pounds. Now, what is curious is that these spiders cannot swim or dive, and when placed on the surface of the water appear to be quite helpless, or nearly so . . . . I eventually succeeded in securing several nearly perfect examples [of their dwellings]. I then saw that the spider does not, as a rule, make its home in the empty tubes of the worms, but . . . . . in the spaces left between the tubes." The dwelling consists of a delicate silken chamber with the opening seaward. "It is so frail and delicate that the least rough handling" destroys it. "Yet in this frail home of silk, hidden away in some little space in the mass of tubes built by marine worms, these spiders live and thrive, ... the waves breaking over them all day long . . . . . I have watched the tubes when the tide was low in the hope of seeing a spider crawling or running about, but I have never yet seen one. They live out of

sight deep down amongst the worm-tubes. How they catch their food, what their food is, and how they keep the sea from drowning them, are questions I have not yet demonstrated, though I have tried again and again to keep them in my marine aquaria. Shortly after introducing one, I have often found it floating helplessly on the water, apparently half dead, and I have had it lifted out of the water and placed on the rockwork, when it soon became active and ran about very quickly, when it appeared to be just like an ordinary spider."

The characters of the species of the genus *Desis* may be tabulated as follows:—

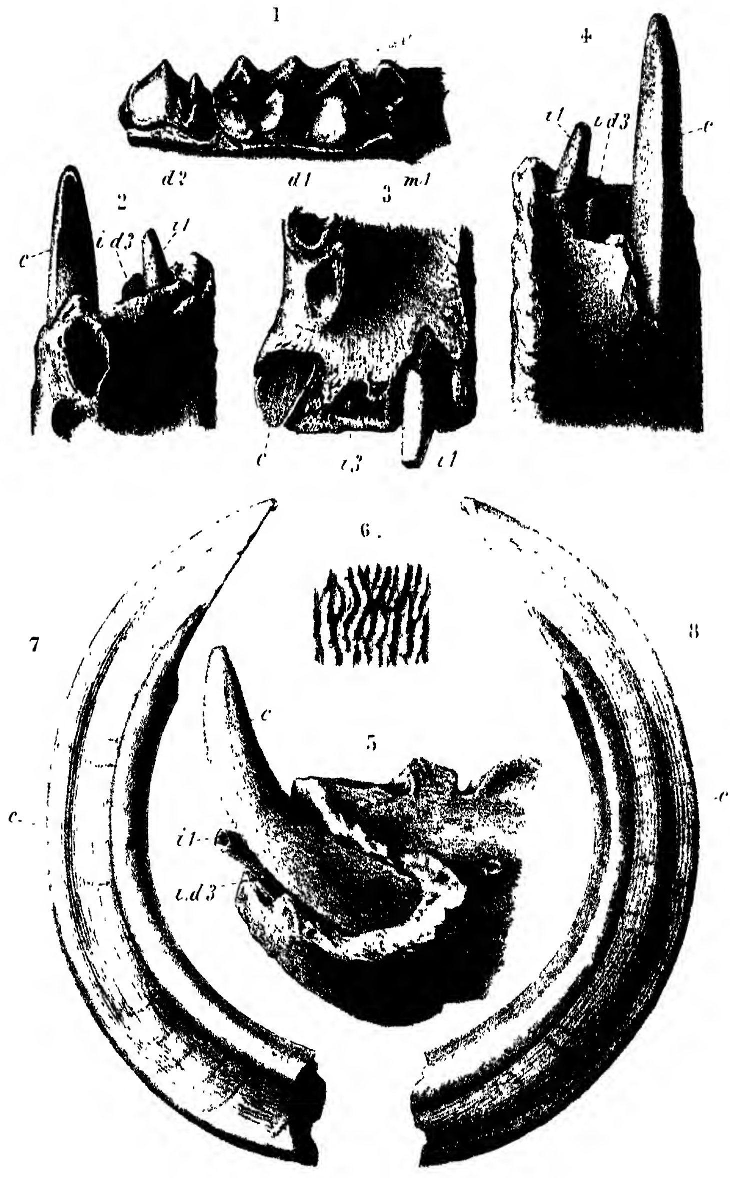
a. Eyes of posterior line subequally spaced; tibia and protarsus of posterior legs strongly spined.
- a^1. Eyes of posterior line closer together, the medians about two diameters from each other and from the laterals.
  - a^2. The two teeth on the posterior border of the fang-groove close together, the distal much larger and closer to the proximal than to the base of the fang (according to Simon) . . . . ***maxillosa.***
  - b^2. The two teeth on the posterior border of the fang-groove wide apart, the distal not larger than the proximal and equidistant from it and from the base of the fang (according to Koch) . ***vorax.***
- b^1. Eyes of posterior line farther apart, the medians about three diameters from each other and from the laterals.
  - a^3. Teeth on posterior border of fang-groove relatively close together, separated only by a space a little exceeding the length of the proximal, the two relatively subequal; teeth of anterior row starting nearer base of fang . . ***martensi.***
  - b^3. Teeth of posterior border of fang-groove far apart, separated by a space equalling about three times the length of the proximal, the distal tooth much the larger of the two; teeth of anterior row starting farther from base of fang .. . . ***marina.***

b. Eyes of anterior and posterior lines very unequally spaced, the distance between the medians and the laterals far greater than that between the medians; posterior legs weakly spined or unspined.
- a^4. Posterior legs without spines (according to Cambridge) ... ***formidabilis.***
- b^4. Posterior legs with tibial and protarsal spines.
  - a^5. Distal tooth on anterior margin of fang-groove remote from the base of the fang and close to the rest of the series; protarsus of 2nd, 3rd, and 4th legs spined only at apex; no median crest on floor of cavity of vulva, and the lateral processes shorter and projecting inwards more at right angles . . . . ***tubicola.***
  - b^5. Distal tooth on anterior margin of fang-groove nearer to base of fang and remote from the rest of the series; protarsus of 2nd, 3rd, and 4th legs with a pair of spines on the proximal side of the scopula as well as at apex; vulva with median crest on floor of cavity, and lateral processes projecting obliquely backwards . .. .. ***kenyonæ.***

The discovery that a close specific relationship obtains between the South African and South Australian species is of the highest interest from a geographical standpoint, as favouring the hypothesis of a direct land connection, accompanied by temperate conditions, between these two continents. All the evidence that

we possess as to the habits of these sea-spiders shows that they live between tide-marks on the shore; and that although gifted with considerable activity on land, they are quite unable to swim and are indeed practically helpless in the water. Hence their presence in S. Africa and S. Australia may be used as testimony to the former extension between these countries, either of a coast-line with shallow water, or at least of a submerged bank, partially exposed at low tide.

It may of course be urged by those who oppose the theory of the former existence of an Antarctic tract connecting the southern continents, that the species of this group of Spiders have reached the coasts of Cape Colony, New Zealand, and Australia by migration in a south-easterly and south-westerly direction from the coasts that border the Indian Ocean on the north. This hypothesis, however, affords no explanation of the fact that no spiders of this genus have been recorded from any spot along the miles of coast-line that intervene between, say, Durban and Singapore. Nevertheless I was myself disposed to adopt the hypothesis of a southward migration to account for the presence of these animals on the coasts of the continents which separate the Indian from the Atlantic and Pacific Oceans, until the example of *D. kenyonæ* came to hand, to testify to the very close affinity between the S. African and Australian types. If the hypothesis of migration from the north be the sole explanation of the distribution of the genus *Desis*, we should expect to find the annectant form between the two types of structure exemplified by, say, *D. formidabilis* from S. Africa and *D. marina* from New Zealand, not in the south, but in the north. As a matter of fact it has turned up in the south, and the most northerly known species, namely *D. martensi* from Singapore, is no nearer to the South African type than is the species that occurs in New Zealand. In my opinion, therefore, the theory of a transoceanic land-connection supplies the most satisfactory explanation of the affinity between the Australian and South African species. Clearly, however, this theory does not necessarily exclude the other entirely. The group may have come down from the north in the first place, and subsequently crossed, either from S. Africa to Australia, or the other way about; but until further light is thrown on the subject by the discovery of species along the western and northern shores of the Indian Ocean, I venture to think the available evidence bearing on the question favours the view that the group originated in the Austro-Malayan Islands and spread westwards from South Australia to S. Africa, along a coast-line connecting the two continents with one another.



A T Hollick del et lith.

Mintern Bros imp

HIPPOPOTAMUS MINUTUS

(From the Pleistocene of Cyprus)

P J Smit del et lith

Mintern Bros imp

HIPPOPOTAMUS MINUTUS.
(From the Pleistocene of Cyprus).

5. On the Pigmy Hippopotamus from the Pleistocene of Cyprus. By C. I. Forsyth Major, F.Z.S.

[Received May 13, 1902.]

(Plates IX. & X.[1])

The present paper deals with some selected specimens from a collection of bones of a pigmy Hippopotamus taken from caves and ossiferous breccias in Cyprus. It gives me great pleasure to announce that this exceedingly interesting first indication of a Pleistocene Mammalian fauna on the island is entirely due to the untiring energy of a young English lady, Miss Dorothy M. A. Bate, who started last year for Cyprus with the express purpose of discovering and exploring ossiferous caves.

Miss Bate is not a novice in cave-hunting. About two years ago, when residing in the Wye valley, she heard of bones having been found in a cave which had been more or less dug up by miners in search of iron-ore. The Natural History Museum owes to her an interesting collection of Pleistocene small mammals from this cave, of which she has published an account in the 'Geological Magazine'[2].

Although Cyprus has been now for over twenty years under British administration, no attempt had been made to investigate the extinct Mammalian fauna of this, the third largest of the Mediterranean islands. But, from what I shall have to say hereafter, it would appear that some scanty remains of a pigmy Hippopotamus of this very same species have been for over one hundred years in certain French museums, and were believed to have come from some locality in the south of France, whereas there are strong grounds for the presumption that they were also in reality from Cyprus.

The first samples addressed to me by Miss Bate several months ago consisted in some much-worn teeth about the size of a pig's molars, which showed no indication of the trefoil pattern so characteristic of the *Hippopotamus* molars. A second small parcel contained a few less-worn teeth, together with a tooth's germ, from which it became at once evident that we had to do with a mammal of the Hippopotamus tribe, about half the size of a middle-sized *H. amphibius*, and the molars of which exhibited a modification of the common *Hippopotamus* pattern, approximating them to a less specialized type of Artiodactyle teeth. The well-known pattern of four trefoils is produced in the *Hippopotamus* molars by crests emanating in a longitudinal direction from the anterior and posterior side of each of the four principal cusps or pyramids, thus obstructing in part the transverse valley between them. In the molars from Cyprus the crests and the grooves separating the former from the cusps are much less developed,

[1] For explanation of the Plates, see p. 112.
[2] Geol. Mag. (4) viii. pp. 101–106 (1901).

with the result that on the worn crown-surfaces triangular and oval-shaped patterns replace the trefoils of the ordinary type (Pl. IX. fig. 1; Pl. X. figs. 2, 3, 4, 6). Another consequence of the lesser development of the longitudinal crests in the fossil teeth is the greater depth and width of the transverse valley and the space between tooth and tooth; thus allowing the cusps of the molars in the opposite jaw to insert themselves in the interstices, so that during mastication the jaws are forced to move in a lateral direction. In *Hippopotamus* proper the crowns are very soon flattened by the longitudinal movement of the jaws. This different mode of wear tends to increase the different appearance of the two kinds of molars; moderately worn teeth of the Cyprus fossil are almost lophodont.

The lower *canines* are not grooved as usually in *Hippopotamus*, but almost smooth, showing only a minute longitudinal striation (Pl. IX. figs. 4, 5, 7, 8); the same may be said of the *incisors* (Pl. IX. fig. 4). From what I have been able to ascertain, there were four lower incisors, at least in the specimens examined.

Some incomplete skulls are among the remains. In one of them (Pl. X. fig. 5) the lacrymal region is preserved, showing that, unlike what is to be found in *H. liberiensis* and *H. sivalensis*, the lacrymal is broadly interposed between the frontal and the maxillary, and an intercalar bone is present at the antero-internal angle of the lacrymal, as is frequently the case in the subfossil Madagascar *Hippopotami*, and not rarely also in the young of *H. amphibius* [1].

It was natural to compare the fossil from Cyprus in the first place with the Pleistocene small-sized *Hippopotami* found in other Mediterranean islands. In Malta caves two species have been found; the larger of the two, *Hippopotamus pentlandi*, which is very abundant in Sicilian caves as well, is not much smaller than *H. amphibius*. The second one, which goes under the name of *H. minutus*, is a much smaller species, but still about one-fifth larger than the Cyprus form. Both the Maltese species show agreement with *H. amphibius* in the trefoil pattern of the molars, and therefore differ from the Cyprus species.

In the Lower Pliocene lignites of Casino (Tuscany) scanty remains of a Hippopotamus occur [2], which agrees with the Cyprus form in the more generalized character of the molars [3] and in the smoothness of the lower canine's enamel coating. A molar presenting almost the same size was shown to me by Dr. Andrews; it was obtained from Wadi Natrun in Egypt; the Hippopotamus as well as the associated mammalian remains show that Wadi Natrun is about the same age as the lignites of Casino, viz. Lower Pliocene. A description of these remains will shortly be given by

[1] See on these topics my observations in Proc. Zool. Soc. 1896, pp. 976–978; as well as in the 'Geological Magazine,' (4) ix. pp. 194–197 (1902).

[2] D. Pantanelli, "Sugli strati Miocenici del Casino (Siena)," Mem. R. Accad. Lincei, (3) vol. iii. p. 12, pl. iv. figs. 1–7 (1879).

[3] H. G. Stehlin, "Ueber d. Geschichte des Suiden-Gebisses," Abhandl. Schweiz. Palæont. Ges. vol. xxvii. pp. 434, 435 (1900).

Dr. Andrews. The Italian and Egyptian Hippopotamus is of superior size to the Cypriotic, and the Casino fossil has been shown to be hexoprotodont.

Perfect agreement in shape as well as in size with the Cyprus creature is presented by Cuvier's "petit Hippopotame fossile" (*H. minutus* Blainv.), as results from the all but forgotten description of it in the 'Ossements Fossiles'[1] and from Blainville's plate vi.[2] The first mention occurs in the "Programme" of the 'Ossements Fossiles'[3], and runs as follows:—"Une espèce d'hippopotame, qui ressemble en miniature à l'hippopotame vivant, mais qui ne surpasse pas la grandeur du cochon. J'en ai découvert les os dans un grès siliceux dont j'ignore le pays." Cuvier had come upon this fossil in the basements of the Paris Museum, without any label to record its origin; some identical remains, likewise of unknown origin, he afterwards received from a private collection in Bordeaux, and from the Cabinet d'Histoire naturelle of a Monsieur Decken in Brussels[4].

To-day, after almost a hundred years, it would be difficult to improve upon Cuvier's description of the few remains, some of which he himself had developed from a lump of ossiferous breccia, in which the bones were cemented by a scanty matrix, a "grès à base calcaire," as stated in the 'Ossements Fossiles.' Blainville, who attempted to improve upon and to criticize Cuvier's description, utterly failed, as he generally did in his invidious attempts to criticize his great predecessor's work.

The only point in which the more copious material before me seems to differ from Cuvier's description is in the interpretation he gives of the difference between the fossil teeth and those of *H. amphibius*, and which he assigns solely to the different mode of wear. As stated before, they are different from the very beginning; cause and effect must not be confused; an oblique wear is resorted to in the fossil teeth because their different conformation calls for it.

As to the locality of the fossils described by Cuvier, it was stated, many years after their first description, that, according to old catalogues of M. Journu-Aubert's private collection in Bordeaux, they had been found ("recueillis") somewhere between Dax and Tartas (Département des Landes) and came into the possession of one Président de Borda, from whom they passed into the private collection of a Monsieur Graves. After the latter's death they became the property of M. Journu-Aubert, who gave one of the blocks to Cuvier[5].

It has never been possible to identify this locality near Dax. In 1869 P. Gervais states[6] that he has failed to gather any new

1 Ossements Fossiles, 2nd ed. i. pp. 322–331 (1821).
2 Ostéographie, Genre Hippopotamus, pl. vi.
3 Journal de Physique, de Chimie et d'Histoire Naturelle, tome lii. p. 268 (Germinal An 9, *i. e.* March & April, 1801).
4 Oss. Foss. 4th ed. i. pp. 490, 491 (1834).
5 *Tom. cit.* pp. 490, 491 (1834).
6 Zool. et Pal. Gén., prem. sér. p. 250 (1867–69).

information about the locality of Cuvier's "petit Hippopotame fossile." From a statement made by Gaudry several years later, it appears that the writer entertained some doubts as to the alleged locality of the *H. minutus*: "M. Tournoüer, qui a si bien exploré le Sud-Ouest de la France, m'a dit qu'il ne connaissait entre Dax et Tartas, au-dessous des sables des Landes, que la mollasse calcaire coquillière à *Ostrea crassissima*, dite *Mollasse marine de l'Armagnac* (Miocène moyen ou supérieur). On devrait donc supposer que les débris d'une espèce d'Hippopotame, c'est-à-dire d'un animal de rivière, ont été déposés dans la mer. Il paraît d'ailleurs que les Hippopotames vont quelquefois à la mer."[1]

In fact, this "Mollasse marine de l'Armagnac" is Tortonian[2]. Now it is quite inadmissible that the same mammalian species should occur in the Tortonian of France and in the Pleistocene of Cyprus. I am not aware that similar remains have since been found in France, nor in any other European locality. Therefore, considering the uncertainty prevailing as to the origin of these remains in French and Brussels Museums, whereas Cuvier's description of the matrix agrees with that adhering to many of Miss Bate's specimens, and especially considering the identity of the species, I do not hesitate to suggest that Cuvier's "petit Hippopotame fossile" may have been brought over from Cyprus.

The ossiferous breccia at Chrysostomo, near Kythræa (Hagia Marina) in the district of Nicosia, where Miss Bate obtained the bulk of her collection, was well known in former times. The Dutch painter and traveller, Corneille le Brun (de Bruyn), was made aware of its existence by the then French Consul at Larnaca, and he travelled to Kythræa "expressément afin d'aller voir un certain lieu situé dans la montagne, où l'on voit les os des hommes et des bêtes qui se sont incorporez à la roche, qui s'entretiennent et qui se sont pétrifiez."[3] From what he further on says, it appears that at that time (end of the seventeenth century) the Greek inhabitants worshipped the place, which they believed to contain the bones of some of their Saints. Le Brun detached some of the bones from the breccia; "le principal fut un os qui ressemble à celui du bras d'un homme, que les anatomistes appellent *radius*." This he took with him to Europe and figured it in his work (No. 193) in two pieces. From the figure it is very evident that the supposed human radius is the femur of the Hippopotamus represented from the posterior side, the larger fragment being the proximal, the smaller the distal portion.

There is a recent form also which claims relationship with the pigmy fossil Hippopotamus. Gervais, almost the only writer of more modern times, who in connection with the study of fossil

[1] Bull. Soc. Géol. de France, (3) iv. p. 504, footnote 1 (1876).
[2] De Lapparent, 'Traité de Géologie,' 4me éd. p. 1525 *et seqq.* (1900).
[3] Corneille le Brun, 'Voyage au Levant, c'est-à-dire dans les principaux endroits de l'Asie Mineure dans les isles de Chio, de Rhodes, de Chypre, etc.' Traduit du Flamand. Delft, 1700, p. 375.

Hippopotami has taken the trouble to look at Cuvier's description[1], says that the shape of the lower incisors and canines of Cuvier's "petit Hippopotame fossile" and of the *Chœropsis liberiensis* from West Africa, which is of the same size, seem to leave no doubt that there is generic identity between both; he therefore proposes to call the fossil *Chœropsis minutus*[2].

The molars of the Liberian form had previously been described by Gratiolet, who states that the trefoil pattern is in this species replaced either by crescents, or by triangles with slightly emarginated sides[3]. On comparison of the molars from Cyprus with those of the specimen of *H. liberiensis* in the Natural History Museum, I find that the trefoil pattern is more effaced in the former than in the latter. The almost unworn molar from Wadi Natrun agrees in this respect with the molars of *H. liberiensis*.

The shape of the molars therefore shows in *H. minutus* the most generalized condition of all the known forms; whereas the conformation of its skull, from the material at present available, appears to be more specialized than in *H. liberiensis* and *H. sivalensis*.

On the whole, so far as actually known, *Hippopotamus minutus* is an early type of the Hippopotamus tribe. Its diminutive size may be partly—as in *H. liberiensis*—a primitive feature, partly a consequence of its restricted habitat.

Like other Mediterranean islands[4], Cyprus seems therefore to have preserved among its Pleistocene fauna little-modified survivors of Tertiary Mammalia.

From his investigation of the recent Molluscan fauna, Kobelt was led to consider Cyprus as an old island ("eine seit langer Zeit abgetrennte Insel"), showing traces of a former connection with the three neighbouring provinces (*i. e.* Asia Minor, Syria, and the region of the Archipelago), without, however, having received any new immigrants since the end of the Tertiary[5].

In this order of ideas it is noteworthy that a Wild Sheep discovered on an island of the Urmi Lake (N.W. Persia) by Mr. Robert Günther has been shown by Dr. A. Günther to be nearly related to the *Ovis ophion* still lingering on the highest summits of Cyprus[6].

[1] Falconer, Leith Adams, and others do not appear to have done so: else they would not have confused the small Hippopotamus from Malta with *H. minutus*.

[2] Zool. et Pal. Gén., prem. sér. p. 250 (1867–69).

[3] L. P. Gratiolet, 'Recherches sur l'Anatomie de l'Hippopotame,' pp. 227–233 (1867).

[4] See my latest contribution to this subject in the Proc. of this Society, Dec. 17, 1901, pp. 625–628, "On *Enhydrictis galictoides*, from the Pleistocene Ossiferous Breccia of Sardinia."

[5] W. Kobelt, 'Studien zur Zoogeographie. II. Die Fauna der meridionalen Sub-Region,' pp. 337–339 (1898).

[6] A. Günther, "The Wild Sheep of the Urmi Islands," Journ. Linn. Soc., Zoology, vol. xxvii. pp. 374–376, pl. 22 (1899).

EXPLANATION OF THE PLATES.

Plate IX.

Teeth of *Hippopotamus minutus* Blainv., from the Pleistocene of Cyprus. The originals of figs. 1–5 are from the Cave of Haghios Jannos, Cape Pyla (south coast); the canine figured, figs. 7 & 8, is from the ossiferous breccia of Chrysostomo, near Kythræa (district of Nicosia).—All figures of the natural size, except fig. 6.

Fig. 1. Fragment of the right mandibular ramus of very young specimen, showing the two posterior deciduous molars (d 1, d 2) scarcely worn, and behind them the anterior portion of the first true molar (m 1), which has not yet completely protruded.

2. Anterior portion of the left mandibular ramus of another very young individual, upper view—exhibiting the canine (c); the much-worn outer deciduous incisor (id 3), without any trace of enamel coating left; and the inner permanent incisor (i 1), which has not yet completely protruded.

3. Anterior portion of the right mandibular ramus of an individual slightly older than the preceding. Upper view. The canine (c), broken at the level of the alveolus, exhibits an almost horizontal section. The outer permanent incisor (i 3) has not yet cut the gum; the inner incisor (i 1) is more advanced.

4. Same specimen as fig. 2; lower view.

5. The same; outer view.

6. Much enlarged view from a portion of the outer enamel coating of the lower canine (fig. 5) near its base; to show the enamel sculpturing.

Figs. 7 & 8. Middle-sized lower canine, probably ♀; right side. Fig. 7, inner; fig. 8, outer view.—The dimensions in millimetres are:—

Length, following the posterior curvature ...	192
Width of inner side	16·5
„ „ outer side	12

The largest canine of the collection presents the following dimensions as above:—195—24—18.

Plate X.

Portions of skull and molar teeth of *Hippopotamus minutus* Blainv., from the Pleistocene of Cyprus. Figs. 1–4 & 6, nat. size; fig. 5, ½ nat. size.—All the figures have been reversed on the Plate.

Fig. 1. Lacrymal region of an incomplete skull; right side. *fr.*=frontal, *n.*=nasal, *la.*=lacrymal, *mx.*=maxillary, *ma.*=malar. Cave Dikomo Mandra, near Nicosia.

2. Right upper true molars of skull, fig. 1; outer view.

Figs. 3 & 4. First and second lower true molars; right side. Fig. 3, [illegible]; fig. 4, upper view. Chrysostomo.

Fig. 5. Upper view of incomplete skull, from the Cave of Haghios Jannos, Cape Pyla.

Fig. 6. The same as fig. 2; lower view.

6. On some new and little-known Butterflies of the Family *Lycænidæ* from the African, Australian, and Oriental Regions. By Hamilton H. Druce, F.Z.S., F.E.S.

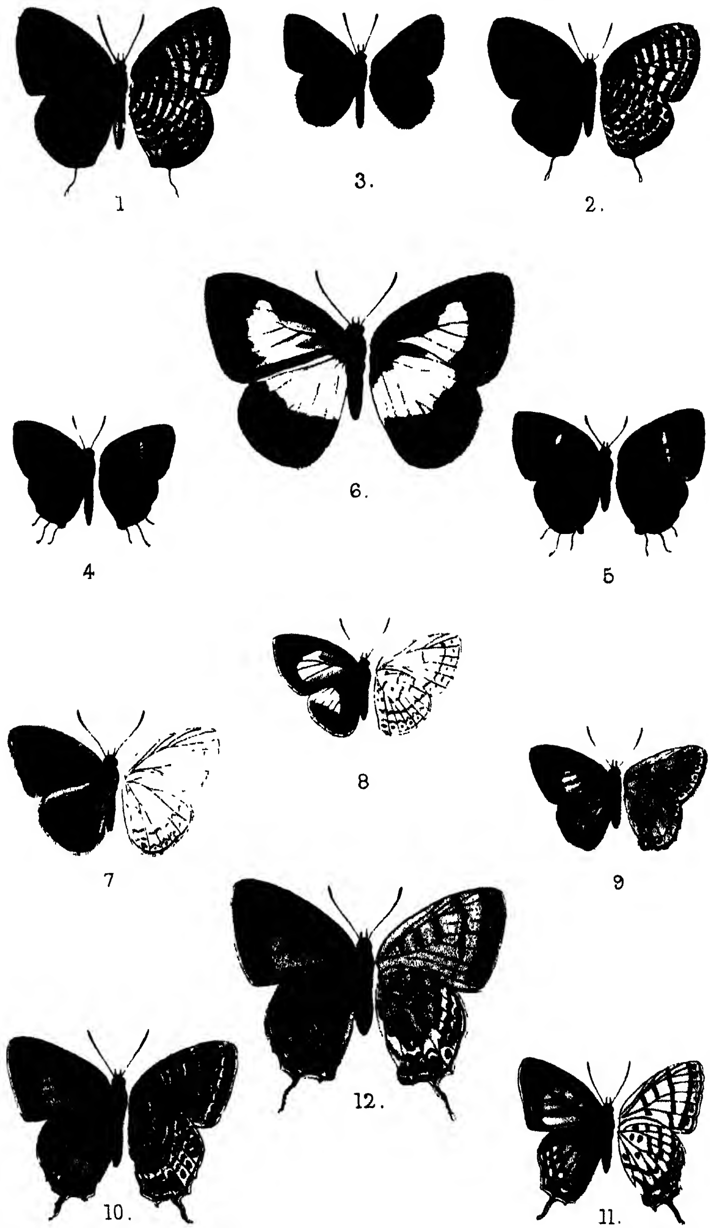
[Received May 14, 1902.]

(Plates XI. & XII.[1])

The following notes and descriptions are suggested by the study of some specimens of Lycænidæ in our own collection, and of some in the Hope Museum at Oxford.

The types of the Australian species described by Herr Semper, and which are now in our possession, have been carefully com-

[1] For explanation of the Plates, see p. 121.



W. Purkiss del et lith.

Mintern Bros. imp.

NEW OR LITTLE-KNOWN BUTTERFLIES
OF THE FAMILY LYCÆNIDÆ

W Purkiss del et lith. Mintern Bros imp.

NEW OR LITTLE-KNOWN BUTTERFLIES
OF THE FAMILY LYCÆNIDÆ

pared, and as they appear to be quite unknown to Australian Lepidopterists, I hope these notes will be found useful.

I am also able to exhibit specimens of several fine species of African *Iolai* which have hitherto been known from descriptions only.

HYPOCHRYSOPS REX Bd., var. BRUNNEA, nov.

The female of this form differs considerably from that sex of typical *H. rex* by the white area on the fore wing above being much reduced in size and scarcely extending into the middle of the cell. The male does not differ from *H. rex* ♂.

Hab. Ferguson Is. (*A. S. Meek*; Mus. Druce).

I believe that *H. epicletus* Felder, which at one time (Trans. Ent. Soc. 1891) I thought could be separated from *H. rex*, must be sunk as a synonym of that species, as we possess several specimens from Aru, collected by Captain Cayley Webster, which are identical with specimens from New Guinea.

We have lately received a female of *H. rovena* mihi from Cooktown, in which the blue suffusion extends all round the white patch on the fore wing above.

TALICADA NYSEUS Guér., var. KHASIA.

This form, which appears to only inhabit the Jaintia and Khasia Hills, is distinguished from the Southern and Western Indian forms by the much larger black spots on the hind wing below, and by the black outer marginal border (containing the row of white lunules) on the fore wing being much narrower, consequently the white area between it and the inner black band is much more extensive. There is almost invariably an elongated black spot on the costa over the middle of the cell. This black spot never occurs in any Southern or Western specimens. The red on the hind wing above is more in the nature of a band in the form *khasia* than in typical *nyseus*. Mr. Moore has figured the Southern form, whilst de Nicéville gives an excellent figure of the Northern insect (Butt. Ind. iii. pl. xxvi. fig. 179). Guérin's figure of his type from Pondicherry shows more white between the black bands on the fore wing below than in any specimens I have come across from S. or W. India, but we possess one from Ganjam agreeing exactly. I have examined a considerable number of specimens, but although the two forms vary slightly *inter se* they can be at once distinguished.

Staudinger's figure, which is said to represent an African specimen, is much like those from S. India. It is, however, without a tail, and has been named *T. ecaudata* by Dr. Butler (Ann. & Mag. N. H. ser. 7, vol. v. p. 61, 1900). The orange patch appears to me to be of much the same tint as in Indian specimens.

NACADUBA ATROMARGINATA, sp. n. (Plate XI. figs. 1, 2.)

♂. Allied to *N. angusta* Druce, from which it differs on the upperside by the outer margins of both wings being distinctly

black-bordered, and by the anal region of the hind wing being strongly suffused with black.

On the underside, the ground-colour is darker and yellower and the bands are more distinct. The two submarginal rows of black spots on each wing are larger and blacker.

♀. Upperside uniform dark brown, with the markings of the underside showing through, slightly whitish in the centre of the disc of the fore wing, and with two or three dull black spots at the anal angle of the hind wing, outwardly margined by a fine white line. When held at an angle, the disc of the fore wing appears slightly suffused with bright blue scales from the base. Underside as in male.

Abdomen brown above; yellowish below. Legs and antennæ spotted with white.

Expanse, ♂ $1\frac{1}{2}$; ♀ $1\frac{3}{10}$ inch.

Hab. S. Celebes (*Doherty*); Tombugu, E. Celebes (*Kuhn*) (*Mus. Druce*).

This appears to be the insect figured by Herr Semper (Reise Philipp. Inseln, p. 177, pl. xxxiii. figs. 1, 2) as *N. azureus* Rober, but a reference to Herr Rober's figure shows an insect with a linear black margin only.

UNA PURPUREA, sp. n. (Plate XI. fig. 3.)

♂. Upperside dull blackish purple, with the outer margins of both wings narrowly and indistinctly black, broadest towards anal angle of hind wings. Underside: fore wing dull greyish brown, yellowish along the costal area; a whitish blotch beyond and closing the end of the cell, followed by another about half-way between it and the outer margin.

Hind wing: basal half pale straw-colour, without markings; outer half russet-brown, with a submarginal row of 4 or 5 dull indistinct blackish spots between the nervules, the largest being between the lower medians—these spots being surmounted by dull straw-colour spaces.

The margins of both wings are very narrowly yellowish between the nervules, and the fringes are dark brown.

Head, thorax, and abdomen blackish above, yellowish below. Antennæ spotted with white.

Expanse 1 inch.

Hab. Lifu I., Loyalty Is. (*Mus. Druce*).

This species, which is tailless, appears to agree exactly in venation with *Una usta* Distant, and like that insect has rather long antennæ and the long hair-like scales about the anal angle of hind wing—this last character, however, is not so marked as in *U. usta.* The eyes are hairy as in that species. *Prosotas*[1] is probably a closely-allied genus, but the antennæ are much shorter.

JAMIDES PHASELI Mathew[2].

This insect is placed by Mr. Miskin (Ann. Queensl. Museum,

[1] *Prosotas* H. H. Druce, P. Z. S. 1891, p. 366.
[2] *Lampides phaseli* Mathew, Trans. Ent. Soc. 1889, p. 311.

no. 1, 1891) in *Lycænesthes*, with a mark denoting that he did not know the species.

I have seen Mr. Mathew's type, which is in Mr. Godman's collection, and find that it belongs to the group of which *J. bochus* Cr. is the best known representative, but is a much duller insect. We have exactly similar specimens from Rockhampton.

WAIGEUM CERAMICUM, sp. n. (Plate XI. fig. 6.)

♀. Allied to *W. subcœruleum* Grose-Smith & Kirby[1], from which it differs on the upper and under side by the white areas of both wings being much more extensive, and consequently by the brown borders being narrower. In addition to the blue scales shown in the figure of the upperside of *W. subcæruleum*, the lower half of the cell of the fore wing is thickly so dusted.

On the underside of the fore wing the costal and outer marginal blue lines are alone present, the blue submarginal band and the streak in the cell are wanting. The submarginal band is partially replaced by whitish. On the hind wing the ultramedian blue band is replaced by a narrow line, and the yellowish-brown marginal border is scarcely discernible.

Expanse 2 inches.

Hab. Ceram (*Wallace*; Hope Coll. Mus. Oxon.).

The type specimen, which is the only one I have seen, is also labelled "Coll. Wallace, Hewitson 1874," and was probably acquired from Hewitson by Professor Westwood as a duplicate.

PHILIRIS INNOTATUS Miskin.

Pseudodipsas innotatus Miskin, Ent. Mo. Mag. p. 165 (1874).

Mr. Miskin, in his Catalogue of the Butterflies of Australia (Annals Queensl Museum, no. 1, 1891), sinks this name as a synonym of *P. ilias* Felder. I cannot, however, agree with him. We have a large series of *P. ilias* from Amboyna captured by Doherty, which do not vary, and which I have compared with Felder's type. *P. innotatus* has the apex of the fore wing and the outer margins of both wings more broadly black-margined. The shape of the fore wings is also quite different: in *P. innotatus* the inner margin is much shorter and the outer margin (which in *P. ilias* is convex) is much straighter, consequently the apex of the wing is very much more pointed.

We have a good series of *P. innotatus* from various parts of N. Australia, and I find that these characters are always present.

Mr. de Nicéville has lately (J. A. S. B. vol. xlviii. pt. ii. n. 2, p. 265, 1898) stated that *Philiris* Rober should be sunk under *Pseudodipsas* Feld., but with this conclusion I do not agree. Certainly the venation appears to be almost identical with that genus, as indeed it does with *Hypochrysops*; but the shape of the wings in the male is quite different, the hind wing being much more elongate towards the anal angle with its outer margin nearly straight. The antennæ also are much longer and more gradually and more extensively clavate.

[1] *W. subcæruleum* Grose-Smith & Kirby, Rhop. Exot. vol. ii.; Oriental Lycænidæ, p. 35, pl. vii. figs. 4, 5 (1896).

P. diggiesi Hew. appears to agree in these characters with the type of *Pseudodipsas*, viz. *P. eone* Feld. Two other species are included by Mr. Miskin (*loc. cit.* p. 67) in *Pseudodipsas*, but I have not seen these. Mr. de Nicéville (*loc. cit.*) appears to have confused *P. ilias* with *P. intensa* Butl. Mr. Miskin also states that he knows *Utica onycha* Hew. from the description and figures only. Probably he knows it well under another name, as it is quite a common species and we have many examples from various parts of Australia and New Guinea, which I have compared with the type in the British Museum. Hewitson's figure, which represents a female, is too highly coloured. *Theclinesthes eremicola* Pagenst. Zoologica, xxvii. p. 123, pl. ii. fig. 9 (1900), appears to be identical with Hewitson's *Utica onycha* and must be sunk as a synonym.

ARRHENOTHRIX PENICILLIGERA de Nicéville.

There appear to be two forms of this species from the Khasia Hills. The larger and typical form has the black apical border more extensive and the blue coloration darker in shade than the smaller form, which has the blue area on the fore wing extending partially up the outer margin from the angle. Large series of each form have been received, and these differences may possibly be seasonal.

TAJURIA THYIA de Nicév.[1], var. PALLESCENS, nov.

♂. Upperside with the blue area much paler, more lavender, and more extensive than in typical *thyia*; in the fore wing extending upwards to the 2nd median nervule, and in the hind wing much closer to the costal margin. The underside is also paler, with the short marks at the ends of the cells clearly defined, and the black spots at the lobe and between the lower median nervules minute and very faintly surrounded with pale yellow.

Hab. Jaintia Hills (*Mus. Druce*).

This form, which may be seasonal, has been received in considerable numbers by Colonel Swinhoe, to whose generosity we are indebted for possessing it. We have typical *T. thyia* also from the Jaintia Hills.

PSEUDALMENUS, gen. nov.

Allied to *Ialmenus*, from which it differs by the costal margin being depressed about the middle, not arched as in that genus, and by the subcostal nervule reaching the margin below the apex of the wing (in *Ialmenus* it reaches the margin above the apex). The cell is shorter and broader, and in the hind wing the median nervure is longer with its branches more nearly equal in length, this being caused by the upper nervule being bent upwards more

[1] *Tajuria thyia* de Nicév. J. B. N. H. Soc. 1892, p. 336, pl. H. fig. 11, ♂.

than in *Ialmenus*. Palpi more robust and hairy and the terminal joint shorter. Eyes smooth.

Type, *Thecla myrsilus* Doubl. & Hew.

EPAMERA SAPPIRUS, sp. n. (Plate XII. fig. 1.)

♂. Upperside closely allied to *E. bellina*, but slightly darker blue, and the lower half of the lobe rather more distinctly white. The anal black quadrate spot is large and distinct.

On the underside this species is more nearly allied to *E. mermis* mihi, and like it has linear dark bands crossing the wings beyond the middle, but not so distinctly black as in that species. The line at the end of the cell in fore wing is almost obsolete. The reddish-orange anal patch is more extensive and reaches upwards to the black line and outwardly to the red spot between the lower median nervules.

Along the centre of this red patch runs a broad line of metallic scales, from the anal margin, zigzag to the red spot and downwards towards the lobe. The apex of the fore wing is slightly brownish. The tuft of hair on inner margin of fore wing below is black.

Frons white; body black above, buff-colour below. Legs white, with black spots. Antennæ black, with small white spots.

Expanse $1\frac{1}{5}$–$1\frac{3}{5}$ inch.

Hab. Sierra Leone; Addah (*Mus. Druce*).

We have long possessed a specimen of this insect which I thought was a variety of *E. bellina*, but the receipt of more specimens has convinced me it is distinct. *E. bellina* has no dark lines below.

I take this opportunity of exhibiting figures of several beautiful species of this group which have hitherto been known only from descriptions, they are as follows:—

E. mermis mihi (Pl. XII. fig. 2), Ann. & Mag. Nat. Hist. (6) xvii. p. 285 (1896).

Argiolaus silas, var. *lalos* mihi (Pl. XII. figs. 3, 4), *tom. cit.* p. 286 (1896).

A. lukabas mihi (Pl. XII. fig. 5), Ann. & Mag. Nat. Hist. (6) v. p. 30 (1890).

A. paneperata mihi (Pl. XII. fig. 7), *tom. cit.* p. 30 (1890).

A. menas mihi (Pl. XII. figs. 8, 9), *tom. cit.* p. 29 (1890).

A. julius Staud. (Pl. XII. fig. 6), Iris, iv. p. 146 (1891).

APHNIOLAUS, gen. nov.

Allied to *Epamera*, and like that genus possessing four subcostal nervules to the primaries in both sexes. Differing, however, by the inner margin of fore wing in ♂ being nearly straight, and by the total absence of secondary sexual characters.

Type, *Myrina pallene* Walleng.

This genus, which contains only one species, appears to connect the group of genera allied to *Iolaus* with *Aphneus*.

Professor C. Aurivillius, in his 'Rhopalocera Æthiopica,' includes several structurally distinct groups under the genus

Iolaus, and at the same time erects a new genus for *I. mermeros* Mabille.

I have lately been able to examine a specimen (♂) of *Iolaus trimeni* Walleng., and find that it agrees in venation with *Epamera sidus* Trimen, and should be placed in the same genus.

Horaga amethystus, sp. n. (Plate XI. figs. 4, 5.)

♂. Upperside dull dark bluish purple, with a minute white spot at end of cell and sharply-defined dark brown margins.

Fore wing: costal very narrowly, outer margin rather broadly dark brown, broadest at apex. Hind wing: costal, outer, and anal margins dark-brown bordered, of about equal width to outer margin of fore wing. A white anteciliary line near the anal extending about halfway up the wing.

Underside rather pale greenish brown, inclined to a more orange shade towards anal regions of hind wing. Fore wing crossed just about the middle by a rather distinct white band, outwardly bordered by a dark brown line, commencing just below the costa and reaching nearly to the inner margin, which is paler.

Hind wing with a rather narrow, but distinct, pale metallic blue band, inwardly bordered by a dark brown line, crossing the wing about the middle from the costal margin to the lower median nervule, where it becomes broken into a number of short streaks and crescent-shaped markings, which are spread over the anal region and inwardly to the inner margin. A rather large black spot on the margin between the lower median nervules, crowned by a metallic blue crescent, and above this spot another minute black speck almost covered with metallic blue. A black spot on the lobe which is small. The marginal space below the submedian nervure is dusted with black and grey scales. An anteciliary black line followed by a narrow white line.

Cilia of fore wing brown; of hind wing brown, tipped with white towards anal angle.

Abdomen brown above, sordid white below; palpi white with black tips; legs white with black spots.

♀. Upperside violaceous blue, with a distinct white spot at the end of the cell, and broad dull brown margins; on the hind wing the blue area scarcely extends beyond the cell.

Underside as in male, but ground-colour paler.

Expanse, ♂ 1 inch, ♀ 1¼ inch.

Hab. British N. Borneo (*W. B. Pryer*).

(Type, ♂ Mus. Druce; ♀ in coll. Hope, Mus. Oxon.)

We have long possessed the male of this apparently very distinct species; it was formerly in Herr Semper's collection, and Professor Poulton has sent me the female for examination.

Herr Frühstoffer (Berlin. ent. Zeit. 1897, 1898) has described several new species of this genus and given lists of those already known, but I can find nothing amongst them that will agree with the one here described.

We have in our possession the types of the various species of *Lycænidæ* described by Herr Geo. Semper in the 'Journal des Museum Godeffroy,' xiv. pp. 154–168 (1878). Many of these are very little known, and I propose to review them here and to give figures of some which are of interest. I take them in the order in which they were published, viz.:—

Danis macleayi, p. 155.
Lampides dubiosa, p. 159.
Holochila marginata, p. 161.
" *helenita*, p. 162.
" *hyacinthina*, p. 162.
" *anita*, p. 163.
Ialmenus dameli, p. 167.

The types of two others described, viz.:

Lycæna sylvicola, p. 159,
Lycænesthes godeffroyi, p. 165

are in the Godeffroy Museum. I do not know them.

THYSONOTIS MACLEAYI.

Danis macleayi Semper, Mus. Godeffr., Lep. xiv. p. 155.

Easily distinguished from *T. taygetus* Feld. by the paler blue in the male, and by the chequered cilia in both sexes.

NACADUBA DUBIOSA Semper.

Lampides dubiosa Semper, Mus. Godeffr., Lep. xiv. p. 159 (1878).

The type of this species consists of the four wings only, the other parts of the insect having been lost. These wings are, however, quite perfect enough to enable it to be determined. It is at once distinguished from *N. berenice* Herr.-Schäff. by the ultramedian band on the fore wing below being more continuous, *i. e.* the lower half not being placed further inwards than the upper half. It has no tail as in *N. berenice*.

CANDALIDES MARGARITA Semper.

Holochila margarita Semp. Mus. Godeffr., Lep. xiv. p. 161 (1878).

This species is very close to *C. absimilis* Feld.; indeed, the only difference I can detect is the shade of blue on the upperside, which is considerably greyer. This of course may only be seasonal.

CANDALIDES HELENITA Semper. (Plate XI. figs. 7, 8.)

Holochila helenita Semp. Mus. Godeffr., Lep. xiv. p. 162 (1878).

I exhibit figures of the type ♂ and ♀ of this species, and an examination of them will show that the ♀ is rather more strongly marked below than the ♂, but that the markings are traceable in the latter sex. *H.* (=*C.*) *androdus* Miskin, P. L. S. N.S.W. ser. 2, v. p. 41 (1890), appears to be very closely allied, if indeed it is distinct. Mr. Miskin does not, however, mention the darker and differently placed scales which appear to be on the median nervules of the fore wing of the type ♂.

Candalides erinus Fabr.

Papilio erinus Fabr. Syst. Ent. p. 525 (1775).
Holochila hyacinthina Semp. Mus. Godeffr., Lep. xiv. p. 163 (1878).

The types show that Herr Semper has redescribed the large form, having identified the form named *subpallidus* by Dr. Lucas as *C. erinus* Fabr., as specimens formerly in his possession prove.

Candalides anita Semper.

Holochila anita Semp. Mus. Godeffr., Lep. xiv. p. 163 (1878).
Lycæna mærens Rosen. Ann. & Mag. N. H. ser. 5, xvi. p. 377 (1885).

Herr Semper's type is in a very bad state of preservation, but a careful examination has proved that it is identical with the type of *L. mærens* in the British Museum. Mr. Miskin, in Ann. Queensland Museum, no. 1, p. 65 (1891), places this and the preceding species referred to under *H. erinus*, but I find it impossible to agree with him. They are differently coloured and marked, and have different shaped wings.

Ialmenus dämeli. (Plate XI. figs. 10, 12.)

Ialmenus dämeli Semp. Mus. Godeffr., Lep. xiv. p. 166 (1878).
Ialmenus illidgei Lucas, P. R. S. Soc. Qd. p. 156, figs. 1, 2 (1889).

I quite agree with Mr. O. B. Lower that the insect described by Dr. T. P. Lucas is identical with Herr Semper's species. The type specimens, which are in fine condition, are exhibited. *I. dämeli* is at once distinguished from *I. ictenus* Hew. by the black linear bands below being replaced by broader buff-coloured bands of a slightly darker shade than the ground-colour. I also exhibit (Pl. XI. fig. 11) a specimen of *I. eichorni* Staud. Exot. Schmett. p. 275 (1888), received from the late Dr. Staudinger under that name from Cooktown. It appears to be quite distinct. *I. itonus* Miskin, P. L. S. N.S.W. ser. 2, v. p. 41 (1890), seems from the description to be identical with this species.

In a footnote[1] will be found described a species of *Ialmenus* which I believe to be quite distinct.

[1] Ialmenus clementi. (Plate XI. fig. 9.)

♂. Allied to *I. inous* Hew. Much smaller. Upperside pale greyish brown, with the blue suffusion less extensive, more brassy, and not reaching into the cell of the fore wing. The anal margin of hind wing is nearly straight and not dentate as in *I. inous*. The black spot on the margin between the nervules is small, circular and distinct, and surrounded by very pale yellow. Underside paler than in *I. inous*, and the bands composed of sordid white, ringed, chain-like markings arranged much as in that species, but less distinct.

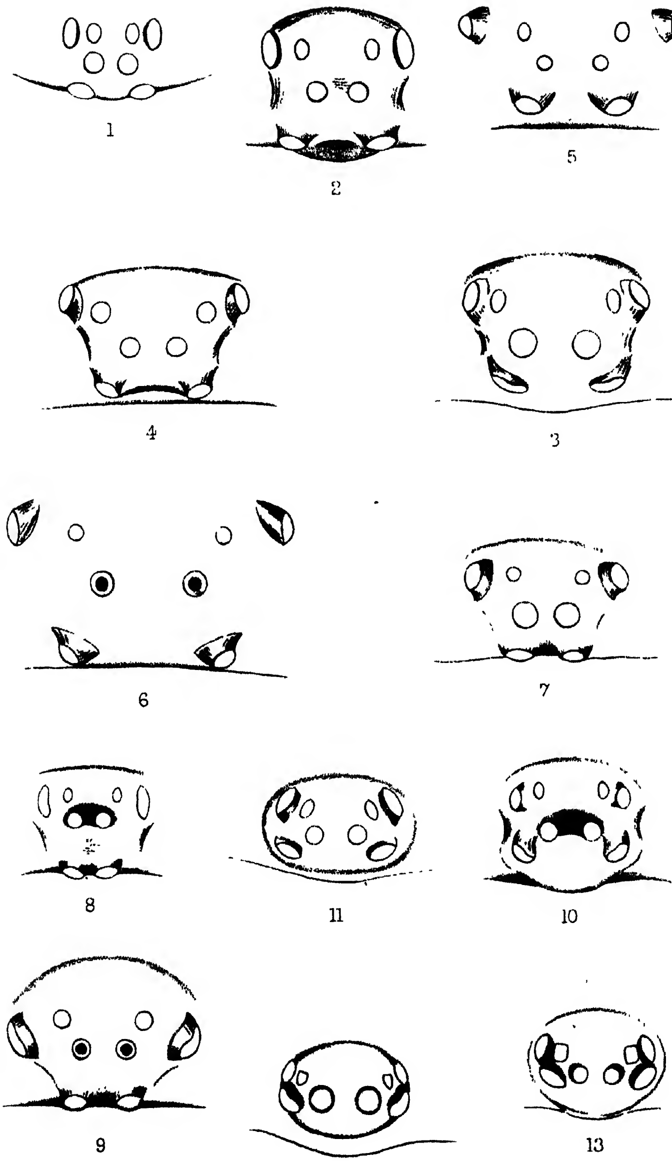
♀. As ♂ but paler, and brassy blue suffusion even less extensive in fore wing above.

Expanse, ♂ 1–1$\frac{1}{16}$ inch, ♀ 1$\frac{1}{4}$ inch.

Hab. W. Australia, Touranna Plains, between Yule River and Sherlock River, Jan. to May (*E. Clement, Ph.D.*).

Four specimens, three of which, including the types, are in the Hope Museum, Oxford, and one in our own, kindly presented by Professor Poulton, F.R.S.

This is the smallest species of the genus described.



H R. Hogg del F.P.C lith

West, Newman imp.

Eyes of Spiders of the sub-order Mygalomorphæ.

EXPLANATION OF THE PLATES.

PLATE XI.

Fig. 1. *Nacaduba atromarginata*, ♂, p. 113.
2. „ „ ♀, p. 114.
3. *Una purpurea*, ♂, p. 114.
4. *Horaga amethystus*, ♂, p. 118.
5. „ „ ♀, p. 118.
6. *Waigeum ceramicum*, ♀, p. 115.
7. *Candalides helenita*, ♂, p. 119.
8. „ „ ♀, p. 119.
9. *Ialmenus clementi*, ♂, p. 120.
10. „ *dämeli*, ♂, p. 120.
11. „ *eichorni*, p. 120.
12. „ *dämeli*, ♀, p. 120.

PLATE XII.

Fig. 1. *Epamera sappirus*, ♂, p. 117.
2. „ *mermis*, ♂, p. 117.
3. *Argiolaus silas*, var. *lalos*, ♂, p. 117.
4. „ „ „ ♀, p. 117.
5. „ *lukabas*, ♂, p. 117.
6. „ *julius*, ♂, p. 117.
7. „ *paneperata*, ♂, p. 117.
8. „ *menas*, ♂, p. 117.
9. „ „ ♀, p. 117.

7. On some Additions to the Australian Spiders of the Suborder Mygalomorphæ. By H. R. Hogg, M.A., F.Z.S.

[Received May 6, 1902.]

(Plate XIII.[1] & Text-figures 22–27.)

A numerous collection of Spiders belonging to the South Australian Museum, Adelaide, very kindly sent me by Professor Stirling, F.R.S., has enabled me to make some important additions to those I enumerated in a paper read to the Society last year (see P. Z. S. 1901, vol. ii. p. 218).

Of the subfamily *Actinopodinæ* there are no specimens. Its Australian genus *Eriodon* Latr. has been located at Perth in the West, and in Victoria and New South Wales to the East; so it might naturally be expected to exist in South Australia, but has not so far been recorded thence[2].

The *Ctenizinæ*, on the other hand, are well represented, and I have to contribute to that subfamily two new genera, *Blakistonia* and *Dyarcyops*, of one species each, and to the Rev. O. P. Cambridge's genus *Aganippe* two new species. As the latter seem to form with *Eucyrtops* Pocock (antice *Aganippe*) *latior* Cambr. (Pl. XIII. fig. 5) and *Aganippe subtristis* Cambr. (Pl. XIII. fig. 6)

[1] For explanation of the Plate, see p. 142.

[2] I may here mention on the authority of the Rev. O. P. Cambridge that his species, *Eriodon formidabile*, has really only *four* spinnerets, as I suggested in the paper above cited, and not *six*, as originally stated (Journ. Linn. Soc., Zool. vol. x. 1868, p. 266).

an almost continuous series, I have reunited Mr. Pocock's genus with its parent.

From Tasmania we have two females of the subfamily *Migince*, which has hitherto comprised in its group *Migeæ* only two genera: *Migas* L. Koch, from New Zealand, and *Moggridgea* Sim., from South Africa. From both of the above these specimens differ essentially, and I have therefore constituted for them a new genus *Heteromigas*.

Of *Barychelinæ* there are no fresh specimens.

Of *Aviculariinæ* one male and six females confirm our previous knowledge of *Selenocosmia stirlingi* Hogg, and I note below a few additional particulars. The male from Cockburn and two females from Broken Hill extend the known southern limit of this species to lat. 32° S. From Palmerston, in the Northern Territory, is a very fine specimen, having much in common with the above, but with a recurved instead of procurved thoracic fovea. This has always been looked upon as a point of great persistence and of undoubted generic importance. I have therefore constituted for it a new genus, *Selenotholus*. A broken specimen included with these is marked *Australia* only. It belongs to the group *Eurypelmateæ*, known only from S. America, and as the origin is not authenticated it is more probable that it has been imported from there than really found indigenous in Australia.

The *Diplurinæ* are represented by specimens from numerous new localities, notably by examples of my genus *Chenistonia*, among which is a well-marked new species. A single male shows in an interesting manner the peculiar median tibial spur which has been the unique distinguishing characteristic of this genus; but it differs from it in having a strongly procurved thoracic fovea and posterior sternal sigilla away from the margin, with other differences looked on as generic characters, and I have accordingly thus distinguished it as the type species of a genus *Dekana*.

Five females from the Adelaide Hills, though lighter in colour, are, without the male, specifically undistinguishable from my Victorian species, *Chenistonia maculata*, from Macedon.

From Tasmania is a new species in the genus *Aname* L. Koch.

The Rev. O. P. Cambridge very kindly placed at my disposal a specimen (female), received by him from Sydney, of the group *Atraceæ* in the above subfamily. This, though somewhat paler than his description, is with little doubt L. Koch's *Hadronyche cerberea*, also from Sydney, but the type specimen of the species not being available it is not certainly known.

The comparison enables me to assure myself that the male I had previously recorded from Macedon, Victoria, and thought might be the unknown male of this species, is certainly not the same. I therefore record the latter now as a new species, *Hadronyche meridiana*. The description appears in the above-mentioned paper (*loc. cit.* p. 274).

Out of 40 specimens sent me in this suborder, comprising examples of nine genera and eleven species, mostly from new

localities in South Australia, but one Tasmanian, no less than five genera and nine species are new, thus emphasizing the fact of how little the members of it move about in the course of very long periods of time.

To a New Zealand genus of the family Ctenizidæ I gave the name (Proc. Zool. Soc. 1901, vol. ii. p. 236) *Maoriana*, which I have since found to be preoccupied for a genus of Mollusca (Trans. N.Z. Inst. xxiii. p. 95). I therefore substitute for it the name *Cantuaria*, reminiscent of the Province from which the specimens named were sent to me.

I do not repeat the references for genera and species given in the paper quoted, as I look on this as supplementary to it.

Subfamily MIGINÆ.

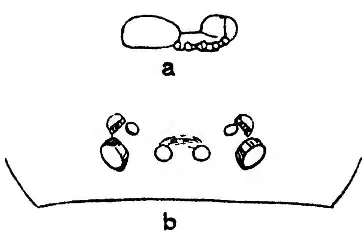
Group MIGEÆ.

HETEROMIGAS, gen. nov.

Heteromigas differs from *Migas* L. Koch in having a straight or slightly procurved thoracic fovea, instead of strongly recurved. The eye-space is broad instead of compact, covering about one-half the width of the frontal area. The clypeus is as wide as the whole eye-space, instead of the front median eyes only. The second and third joints of the superior spinnerets are compressed into the first joint, their presence being hardly more than indicated.

Type species, *H. dovei*.

Text-fig. 22.



Heteromigas dovei.
a, profile (nat. size); *b*, eyes.

HETEROMIGAS DOVEI, sp. nov. (Text-fig. 22.)

Cephalothorax, mandibles, lip, and maxillæ rather light yellow-brown, the eye-space black at each end and between the front middle eyes; sternum, coxæ, legs, and palpi somewhat brighter yellow, with dark grey or brown hairs, spines, and bristles; abdomen dark grey, without recognizable pattern.

The *cephalothorax* is rather longer than broad, narrowed posteriorly, but broad in front. The cephalic part is rounded

and rises abruptly from in front of the thoracic fovea almost as prominently as in *Eriodon*, the mandibles being continued in the same manner, but, as in all the *Migineæ*, falling nearly perpendicularly after a short, more or less kneed, horizontal length. The fangs are long and very powerfully formed, with a transverse section almost square by reason of four strengthening longitudinal ridges. There is no rastellum. On the inner edge of the falx-sheath are three large teeth, on the outer four, and five or six small, intermediate, near the base of the fang. The eye-space, three times as wide as long, extends half the width of the front of the cephalic part. The front median *eyes* are 1½ diam. apart, and two of their diameters from the nearest point of the laterals, which are oval and two diameters of the median in greatest length. The whole row is slightly procurved.

The posterior row is recurved, shorter than the front row, and the laterals only slightly more in longer diameter than the front median. The rear median, in long diameter the same as these, are half that distance from the rear side and their diameter from the front middle. The clypeus is wide, the front median being removed from the margin by a distance equal to the whole breadth of the eye-space. The thoracic fovea is deep, wide, and nearly straight, but with a distinct tendency to procurvature.

The *maxillæ* are broad and nearly square, the lower outer corner being somewhat rounded. There are spines along the inner side margin but not along the lower side. The *lip* is as long as broad, slightly rounded in front, and in one piece with the sternum, though separated by a depression containing the anterior sigilla; it has no spines.

The *sternum*, smooth and strong, is piriform, narrowed, and slightly hollowed in front. The posterior sigilla are large and situated near the central line, the remainder marginal.

The *abdomen* is oval, 1½ times as long as broad. The superior spinnerets are short and stout, the first joint making the whole of their length, and the second and third joints indicated by only slightly raised circular rims successively inside one another. The inferior spinnerets are cylindrical, truncate at top, about 1½ diameters apart. The *palpi* are longer than in the *Migineæ* generally, more nearly approaching those of the Ctenizidæ. The femoral joints are much curved round the mandibles and as long as the patella cum tibia. The distal segment is broad at base, but tapering, and furnished with two rows of short, stout, curved spines as on the tarsus and metatarsus of the front two pairs of legs.

The *legs* are short and stout, the metatarsus and tarsus of the front two pairs being somewhat flattened and having two rows of stout, curved, spines along their inner and outer margins. The superior tarsal claws have two pectinations on the inner, and one long one near the base, on the outer margin. The inferior claw is smooth.

Two females from Table Cape, North Coast of Tasmania. Collected by Mr. Dove.

Measurements in millimetres.

	Long.	Broad.
Cephalothorax ...	6	5
Abdomen	$7\frac{1}{2}$	5
Mandibles...... ..	3 total length.	$1\frac{1}{2}$ horizontally.

		Coxa.	Trochanter & femur.	Patella & tibia.	Metatarsus & tarsus.		
Legs...	1.	2	4	4	3	=	13
	2	2	4	4	3	=	13
	3.	2	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	=	$12\frac{1}{2}$
	4.	2	5	5	5	=	17
Palpi		$1\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	2	=	$10\frac{1}{2}$

Subfamily CTENIZINÆ.

The following synopsis will serve to distinguish the Australian and New Zealand genera :

1. Abdomen corrugated, two strongly marked muscle-spots on upper side of abdomen. The eyes of the front row situated at the four corners of a trapezium markedly longer than broad — *Idiosoma*. (Pl. XIII. fig. 8.)
   Abdomen smooth or hairy, but with no corrugations. Trapezium formed by the four eyes of the front row, in all cases broader than long — 2
2. Front row of eyes procurved ; but a line touching the upper points of the laterals lies not more than $\frac{1}{2}$ their diameter below that touching the lower edge of the median pair . — 3.
   Front row of eyes so much procurved that a line joining the upper points of the laterals lies at least their diameter below one touching the lower edges of the median . . .. — 5.
3. The line joining the centres of the rear row of eyes straight or recurved .. .. — 4.
   The line joining the centres procurved .. .. — *Dyarcyops*, gen. nov.
4. Posterior sternal sigilla moderate in size and marginal .. . . — *Arbanitis*. (Pl. XIII. fig. 11.)
   Posterior sternal sigilla large and removed from the margin . . — *Cantuaria*.
5. The line joining the lowest points of laterals of rear row of eyes passing below the centres of the median pair of the front row — *Anidiops*. (Pl. XIII. fig. 9.)
   The line joining the lowest points of laterals of rear row of eyes passing above the upper points of the front medians . ... — 6.
6. The whole eye-space much broader than long ($1\frac{1}{2}$–$2\frac{1}{2}$ times) ; the front two pairs of legs scopulated on tarsi only . . — *Aganippe* (including *Eucyrtops* Poc.)
   The whole eye-space more nearly square, the breadth not exceeding $1\frac{1}{4}$–$1\frac{1}{2}$ times the length ; the metatarsi of front two pairs of legs scopulated............. ... . — *Blakistonia*, gen. nov.

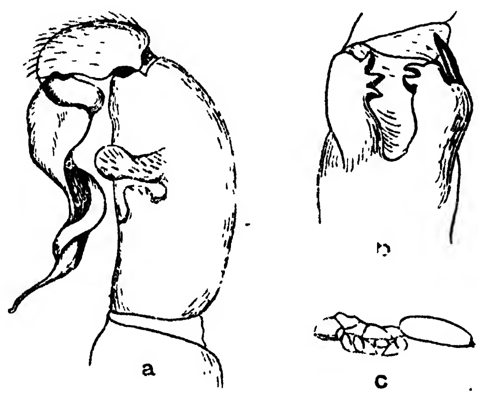
I append for comparison a series of diagrams of the eyes of members of this subfamily, showing the manner in which they vary. I have carefully measured the various specimens from which they are taken and drawn all to the same scale (× 10).

Genus AGANIPPE Cambr.

Synopsis of Species.

1.	The laterals of the front row of eyes one diameter only apart in male, at least .	*A. smeatoni*, sp. nov.
	The laterals of the front row of eyes not less than about two diameters apart . .	2.
2.	The whole eye-space about $2\frac{1}{4}$ times as broad as long .	*A. latior* Cambr.
	The whole eye-space clearly less than twice as broad as long . . .	3.
3.	Lateral eyes of the front row about two of their diameters apart	*A. pulleinei*, sp. nov.
	Lateral eyes of the front row more nearly four diameters apart	*A. substriata* Cambr.

Text-fig. 23.



Aganippe smeatoni.

a, male palp: *b*, anterior end of tibia i. of male from inner side; *c*, profile (nat. size).

Genus AGANIPPE Cambr.

AGANIPPE SMEATONI, sp. nov. (Plate XIII. fig. 7 & text-fig. 23.)

Cephalothorax and mandibles rich yellow-brown; lip, maxillæ, sternum, and coxæ somewhat brighter, with rather pale yellow hair, short and fine, and short stout dark brown bristles. Legs yellow-brown, lighter than cephalothorax. Abdomen yellow above with darker brown median area, underneath dark yellow-grey; in some specimens the upper median area is almost black.

The *cephalothorax* is longer than broad, narrowed to nearly one-half both anteriorly and posteriorly, rounded at sides. The cephalic part rises gradually from a deep fovea and side depressions to the eye-space, behind which is a transverse depression. The cephalic fovea is straight or slightly procurved and lies at the bottom of an elliptical depression. A fringe of stout short procurved spiniform setæ runs round the margin of the thoracic area, and there are two broad depressions on each side from the end of the fovea to the margin.

The front median *eyes* are half their diameter apart, the laterals of the same diameter, three-fourths of a diameter away, lie in front of them near the margin of the clypeus, one diameter only apart. The clypeus is about half their diameter in breadth. The rear row is straight, the oval laterals of the same diameter as the front, total length of the row being twice that of the front lateral pair, or six long diameters. The rear medians are very round, half the diameter of the other eyes, four diameters apart, $1\frac{1}{2}$ from the laterals and the same from the front median.

The *mandibles* are short and protrude horizontally not more than one-fourth of the length of the cephalothorax. The *lip* is broader than long, straight in front, and without spines. There are a few spines on the inner side of the *maxillæ*, near the base; they are rather thickly covered with hair, straight in front, and only pointed in the middle of the basal end.

The *sternum* is ovate, rather wide posteriorly, covered with upright bristles on round bases. The posterior sigilla are as far from the median line as they are from the margin. The stigma of the male *palp* is rather long and twisted like a ram's horn; between the large bulb from which it springs and the metatarsal joint is a smaller bulb. On the tibial joint is a double apophysis thickly covered on the outside with short tapering three-sided spines.

The *legs* are rather long and thin. The whole of the metatarsi are bespined; on the tarsi of all legs, except the first pair, are stout spiniform setæ. The front two pair of tarsi are scopulated, but in one specimen, which shows no other difference, there is no scopula on tarsus i. A double apophysis at the anterior end of tibia i. has a stout spine and two horny knobs on the outer half, and three knobs, but no spine, on the inner. The superior tarsal claws have from 4 to 9 teeth, the inferior being bare. The abdomen is oval and is thickly covered on the upper side with stout spines on rounded bases. The superior mamillæ are short and stout, the first joint longer than the other two together, the last being quite short.

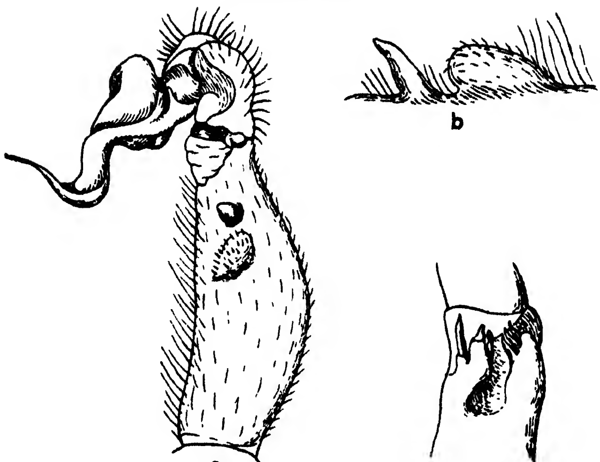
There are four males sent by Mr. T. D. Smeaton, of Blakiston, but without locality indicated, and I have named the species after him.

The measurements in millimetres are as follows:—

	Long.	Broad.
Cephalothorax ...	8	{ 4 front. 7
Abdomen	9	7
Mandibles	4	2 horizontally

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	4	10	9	8	=	31
	2.	4	$9\frac{1}{2}$	$8\frac{1}{2}$	$7\frac{1}{2}$	=	$29\frac{1}{2}$
	3.	4	8	7	$9\frac{1}{2}$	=	$28\frac{1}{2}$
	4.	4	$10\frac{1}{2}$	10	12	=	$36\frac{1}{2}$
Palpi		3	$5\frac{1}{2}$	$5\frac{1}{2}$	2	=	16

Text-fig. 24.



Aganippe pulleinei.

a, male palp; *b*, apophyses on tibial joint of palp from side; *c*, anterior end of tibia i. of male from inside.

AGANIPPE PULLEINEI, sp. nov. (Plate XIII. figs. 3, 4, & text-fig. 24.)

Cephalothorax, mandibles, lip, maxillæ, and sternum bright yellow, the eye-space mostly black; the coxæ and femora of the legs are orange, the patellæ and tibiæ darker; the metatarsus and tarsus yellow. On the mandibles are rather long brown hairs, but elsewhere the hairs are all changed to bristles, and on the legs amd sternum into spines. The abdomen is yellow, with brown spinous setæ on the upper part.

The *cephalothorax* is longer than broad, narrowing in front to less than half its total width. The cephalic part, moderately raised and rather narrow, is bounded by a rather deep side depression. The fovea is straight or slightly procurved; a row of stout setæ extends round the margin. The *mandibles* are short but rather more protrudent than the last described, the fangs long and curved. There are seven rather small teeth on each of the edges of the falx-sheath and five quite small in an intermediate row.

The *lip* is at least twice as broad as long, slightly hollowed in front and without spines. The *maxillæ* are rounded at base and straight in front, without prominences. A few spines on the inner lower corner.

The *sternum* is piriform, half as broad in front as between 2nd and 3rd legs, clothed with short upright spinous bristles on bases. Posterior sigilla away from margin.

The *palpi* are twice the length of the cephalothorax, the tibial joint of the male being considerably swollen in the middle, and with two apophyses, one above the other, on the side. The stigma is $1\frac{1}{2}$ times as long as the bulb, and is twisted, but not so much as in *A. smeatoni.*

The front middle *eyes* are $1\frac{1}{4}$ diameters apart. In the male these are as large as the long diameter of the laterals, but in the female only $\frac{4}{5}$ths. The front laterals are two of their diameters apart; they are in the male the long diameter away from the median, in the female $1\frac{1}{2}$. The rear row is recurved, both laterals and median oval, the latter in the female being as large as the front median, from which they are distant the diameter of the side eyes. They are somewhat nearer than this to those of the rear side, which are as long as the front side eyes. The trapezium formed by the rear median and front laterals is very slightly narrowed in front.

The *legs*, rather thin and tapering, are somewhat thickly covered with bristly spines. The apophyses at the anterior end of tibia 1 of the male are hardly to be distinguished from those of *A. smeatoni.* The pectinations on the superior tarsal claws vary from 7 in front to 3 on the outer rear claw.

The *abdomen* is oval, the upper side being furnished with spiniform setæ, both upper and under side are covered with short fine hair.

The superior spinnerets are short and stout, the first joint longest, the third quite short. The inferior are one diameter apart.

The female is coloured the same as the male, and is probably not fully grown; except in the smaller size of the front middle eyes she does not differ from the males, and comes from the same locality, so that I take them to correspond. Three males and the female come from Blakiston, and one male from the coast at Hallett's Cove. I have named them after the sender of the latter, Mr. W. Pulleine, jun.

Measurements in millimetres.

	Male Long.	Male Broad.	Female Long.	Female Broad.
Cephalothorax ...	10	4 / $8\frac{3}{4}$	$8\frac{1}{2}$	5 front. / 7
Abdomen	11	9	$10\frac{1}{2}$	$8\frac{1}{2}$
Mandibles	$4\frac{1}{2}$ / 4 horizontally.		5 / 4 horizontally.	

Male.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	5	11	11	11	=	38
	2.	$4\frac{1}{2}$	11	11	$11\frac{1}{2}$	=	38
	3.	4	10	$9\frac{1}{2}$	13	=	$36\frac{1}{2}$
	4.	$4\frac{1}{2}$	$12\frac{1}{2}$	$12\frac{1}{2}$	17	=	$46\frac{1}{2}$
Palpi		$4\frac{1}{2}$	7	$6\frac{1}{2}$	2	=	20

Female.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	4	6	6	4	=	20
	2.	$3\frac{1}{2}$	6	6	4	=	$19\frac{1}{2}$
	3.	3	$6\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{1}{2}$	=	$20\frac{1}{2}$
	4	$3\frac{1}{2}$	$8\frac{1}{2}$	$8\frac{1}{2}$	$7\frac{1}{2}$	=	28
Palpi		$3\frac{1}{2}$	$5\frac{1}{2}$	$4\frac{1}{2}$	3	=	$16\frac{1}{2}$

DYARCYOPS, nov. gen.

Dyarcyops differs from *Arbanitis* L. Koch, to which it is allied, in having both rows of eyes procurved, the front median eyes more than their diameter apart, the cephalic part of the cephalothorax comparatively high, the thoracic fovea straight, deep, and long; it has only a few pectinations on the superior tarsal claws; and, from the greater procurvature of the front row, the whole eye-space is longer in comparison with its breadth than in the above-named genus.

Type species, *D. andrewsi*.

DYARCYOPS ANDREWSI, nov. sp. (Plate XIII. fig. 10 & text-fig. 25 *a*.)

Cephalothorax dark reddish brown, with fine yellowish-brown hair; mandibles darker still, with brown hair or bristles. Sternum, lip, maxillæ, and coxæ rich yellowish brown, with long brown hair, rather inclined to yellow on the maxillæ and red on the fringes. Legs and palpi yellow-brown, abdomen dark grey reticulated spots on yellow-brown ground.

The thoracic part of the *cephalothorax* is rather flat, the cephalic part rising somewhat abruptly from in front of the fovea, which is broad, deep, and transversely straight.

The whole cephalothorax, somewhat broad in front, is one-third longer than broad, and longer than the patella and tibia of any of the legs. The mandibles are large and extend below the base of the cephalothorax. The abdomen is ovate, rather straight in front: the superior spinnerets short and stout, the first joint longer than the other two together, the third quite short and almost hemispherical; the inferior one diameter apart.

The front row of *eyes* is strongly procurved, the laterals $1\frac{1}{2}$ diameters of the medians, having their highest part below the lower margin of the latter pair, which are one and a third of their diameter apart. The rear side eyes are slightly smaller than the front, and separated from the latter by two of their own diameters. The centres of the rear medians are on a level with the upper part of the laterals, making the whole row clearly procurved. The total eye-space is well raised up and $1\frac{1}{2}$ times as broad as long.

The *mandibles* are stout and long, well arched, and their lowest point reaches to below the level of the sternum. The fangs are long and powerful. The rastellum consists of two rows of stout

teeth, reaching halfway across the front and some distance up the inner edge of the falx. The teeth on the falx-sheath consist of five large and three smaller on the inner edge and five at the lower end of the outer edge.

The *maxillæ* are broad, straight in front, with only a small protuberance on the inner corner. The lower end is rounded and curved in round the lip, that portion being rather thickly studded with spines. The *lip* is sunk below the maxillæ; it is about as long as broad, straight in front, and without spines.

The *sternum* is broadest opposite the third pair of coxæ, where the fourth pair of sigilla show prominently a little away from the margin, the others being marginal.

The *abdomen*, rather deeply pitted, is covered with fine hair and a few bristles on roots on the upper side: it is longer than broad, somewhat ovate truncate in front and rounded at rear. The superior spinnerets are short and stout, the first joint longer than the other two together, the third being almost hemispherical; the inferior pair are about their diameter apart.

The *legs* are rather short and stout, the fourth pair scarcely longer than the first. The metatarsi and tarsi of front two pairs are thickly scopulated, but none on either joint of third and fourth pair. The superior tarsal claws are long, stout, and strongly curved, having one longish pectination near the base on the outer claw and two on the inner. The third claw is smooth, and there is one pectination at the base of the female palp-claw.

Four females (two not quite adult), taken by Mr. F. W. Andrews at Mount Compass, South Australia.

Measurements in millimetres.

	Long.	Broad.
Cephalothorax .	12	7 in front. 9
Abdomen	11	7
Mandibles	$6\frac{1}{2}$	4 horizontally.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	5	11	10	8	=	34
	2.	$4\frac{1}{2}$	9	9	7	=	$29\frac{1}{2}$
	3.	$3\frac{1}{2}$	8	6	7	=	$24\frac{1}{2}$
	4.	$4\frac{1}{2}$	10	11	9	=	$34\frac{1}{2}$
Palpi..............		5	9	$7\frac{1}{2}$	5	=	$26\frac{1}{2}$

Blakistonia, nov. gen.

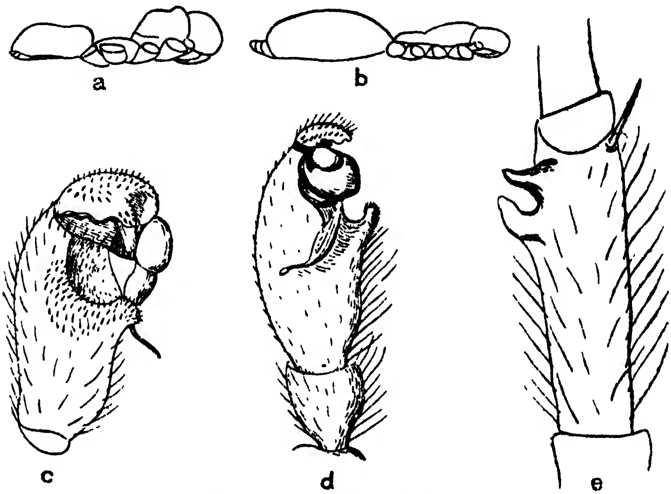
I have somewhat doubtfully constituted a new genus for two females from the same neighbourhood as the two new species of *Aganippe*, which I call, after the locality, *Blakistonia*.

It differs from *Aganippe* in the much squarer eye-area; the rear side eyes are larger than any of the others. The lip is as long as broad, furnished with short, stout, unusually tapering spinules;

the third joint of the spinnerets only slightly shorter than the second; stouter legs, the metatarsi of the front two pairs scopulated, all tarsi bespined, and different type of apophyses on tibia i. of male.

Type species, *B. aurea*.

Text-fig. 25.



Dyarcyops andrewsi (*a*) and *Blakistonia aurea* (*b–e*).

a, *b*, profiles (nat. size); *c*, male palp from inner side; *d*, male palp from outer side; *e*, tibia i. of male from under side.

Blakistonia aurea, sp. nov. (Plate XIII. figs. 1, 2, & text-fig. 25 *b–e*.)

Female. Cephalothorax dingy yellowish brown, mandibles brown, rastellum nearly black, lip and maxillæ yellowish brown; sternum pale yellow, with deeper orange spots; legs yellowish brown, with dark grey hair on patella, tibia, tarsus, and metatarsus; abdomen bright golden yellow, with pale yellow hair on both upper and under side.

The *cephalothorax* is longer than broad by nearly one-fourth, and only one-fourth narrower in front and rear than in the widest part. The cephalic part is well raised up from the slightly procurved thoracic fovea, bounded by side depressions and highest behind the eye-space. The mandibles are prominent, more than one-third the length of the cephalothorax horizontally. Teeth as in male.

The eye-space is unusually depressed, in fact barely raised up at all. The front median *eyes* are their diameter apart; the laterals, which are $1\frac{1}{2}$ diameters of same, are two of their own diameters apart, two diameters of the median away from the latter, and situated on the margin of the clypeus, thus forming an

entirely separate row. The centres of the rear row are in a straight line, all four eyes oval and longitudinally parallel. The long diameter of the median equals that of the front middle eyes, and the rear laterals, twice the length of these, are one-third of their length away from the medians, which are not quite three of their own long diameters apart.

The *lip* is as long as broad, very convex, rounded at the base, and straight in front. It is furnished with rather thick ordinary bristles and stout spines on the upper half, tapering from base to point. The *maxillæ* are rather wide, rounded at the lower outer corner and curving round the lip. They are straight in front. On the inner lower corner they have an area with spines, much like those on the lip, but longer.

The *sternum* is piriform, narrowest in front; the posterior sigilla are moderate in size, about their diameter from margin, the remainder close to it.

The *legs* are rather short and stout. The metatarsus and tarsus of front two pairs somewhat flat, thickly scopulated, and particularly short, with stout spines on the under side of both joints. The superior tarsal claws have from one to three long basal pectinations only and are much curved. The third claw is small and bare.

The *abdomen* is oval, with fine down-lying hair and long fine bristles on the upper part. The superior spinnerets are short and stout. The first joint about equal to the other two, the third hemispherical at the anterior end. The inferior spinnerets are very small and about their diameter apart.

Male. Colouring like the female. The long dark spinous bristles on the upper part of abdomen give the latter a darker colour than in the female (supposed). The under side also is covered with thicker and longer brown hair.

The front median *eyes* are of the same diameter as the front laterals, the former $\frac{1}{2}$ and the latter $1\frac{1}{4}$ diameters apart. The rear row is straight, the laterals being in long diameter larger than those of the front row. The whole eye-space, though of the same proportionate length and breadth, is only two-thirds the size of that of the (supposed) females, but the eyes appear closer together owing to their larger comparative size. A long median row of long spinous bristles runs from near the thoracic fovea to the margin of the clypeus.

The *lip* and *maxillæ* are unbespined. The sternum is pear-shaped; the posterior sigilla away from margin, small and apparently slightly convex. The teeth on the inner edge of the falx-sheath are small and six in number. On the outer edge and intermediately are 14 or 15 spread indiscriminately, some very small. The *legs* are long and rather thin. The superior tarsal claws have five or six pectinations. The tarsi of the front two pairs only are scopulated and the anterior end of the metatarsus. Near the anterior end of tibia 1 are two horny apophyses longitudinally, one below the other on the inner side. There are spines on all metatarsi and on tarsi 3 and 4, but not on 1 and 2.

On the outer side of the tibial joint of the palpi is one apophysis near the anterior end, its upper side covered with small triangular spinules and a considerable area behind it. The cap of the metatarsal joint is also similarly covered with spinules. The stigma is nearly twice the length of the bulb, pointed at the end and twisted into a thin laminated sheet about the middle.

One male from Lower North Road, Adelaide.

Four females from Blakiston and the Mt. Lofty ranges.

Measurements in millimetres (female).

	Long.	Broad.
Cephalothorax ...	11	{ 4 in front. 8
Abdomen	16	11
Mandibles	4 horizontally.	

Superior spinnerets 2, 1, $\frac{1}{4} = 4\frac{1}{4}$.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	$4\frac{1}{2}$	8	$7\frac{1}{2}$	$5\frac{1}{2}$	=	$25\frac{1}{2}$
	2.	4	$7\frac{1}{2}$	7	$5\frac{1}{2}$	=	24
	3.	4	7	$6\frac{1}{2}$	5	=	$22\frac{1}{2}$
	4.	$4\frac{1}{2}$	8	10	8	=	$30\frac{1}{2}$
Palpi..............		$4\frac{1}{2}$	7	6	4	=	$21\frac{1}{2}$

Measurements in millimetres (male).

	Long.	Broad.
Cephalothorax ...	7	{ 4 in front. 6
Abdomen	7	4
Mandibles	3	2 horizontally.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	$3\frac{1}{2}$	8	9	8	=	$28\frac{1}{2}$
	2.	3	$7\frac{1}{2}$	8	$7\frac{1}{2}$	=	26
	3.	3	6	$6\frac{1}{2}$	$7\frac{1}{2}$	=	23
	4.	3	8	10	10	=	31
Palpi..............		3	5	5	2	=	15

Spinnerets ...... 1, $\frac{3}{8}$, $\frac{3}{8} = 1\frac{3}{4}$.

Inferior do. very small, about $\frac{1}{4}$, and close together.

Subfamily Aviculariné.

Group Selenocosmieæ.

Selenotholus, nov. gen.

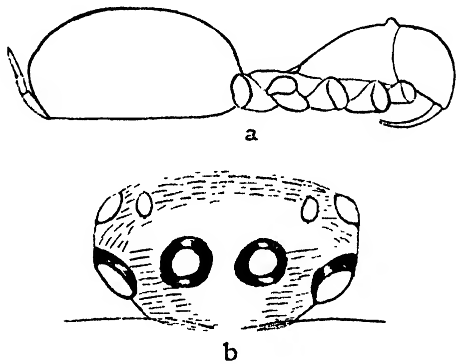
Differs from *Selenocosmia* in having the thoracic fovea recurved. Rear and front legs of equal stoutness.

Type species, *Selenotholus foelschei*.

SELENOTHOLUS FOELSCHEI, nov. sp. (Text-fig. 26.)

Female. The cephalothorax is reddish, covered with short yellow to yellow-brown hair. Mandibles darker, with thick, but smooth downlying yellow-brown hair, darkest in front; fangs black-brown, but the outer side by palp bright red. Lip and maxillæ red-brown with reddish hair. Sternum and coxæ deep brown: rest of legs and palpi same as mandibles; the patella of third and fourth pairs somewhat darker. The abdomen, both upper and under sides, is a rich golden brown covered with smooth glossy hair.

Text-fig. 26.



Selenotholus foelschei.

a, profile (nat. size); *b*, eyes.

The *cephalothorax* is one-eighth part longer than broad, sloping moderately upwards from the clearly-recurved thoracic fovea lying between the second and third pair of legs to the eye space, which is more than $2\frac{1}{2}$ times as broad as long and situated on a tubercle, $3\frac{1}{2}$ mm. × 2, reaching to the margin of the carapace.

The front row of *eyes* is slightly procurved, the median pair $1\frac{1}{2}$ diameters apart and $1\frac{1}{4}$ of their diameter from the laterals; they are of a bright orange colour, standing on transparent black rims, which I have not allowed for in their size. The front laterals are $1\frac{1}{2}$ times the diameter of the median, and, together with the rear row, are of a pale yellow. The rear row is straight; the laterals, half the diameter of the front laterals, are as far from them as the latter from the front median. The rear median, slightly smaller than the laterals in long diameter, are their breadth away from the latter and twice their length from the front median and ten times their own breadth, or five diameters of the front middle, apart.

The *mandibles* are thickly covered with close-lying hair, the fangs long and powerful, the inner margin of falx-sheath furnished with about 12 large teeth, and the intermediate area with about 50 smaller, reaching almost to base of fang. The stridulating-

organ on the outer side of the falx is spread over a more or less oblong area, and consists of series of sharp spines placed in very regular rows. The corresponding portion on the base of the palpi is a long oval area of spines, shorter and broader but generally similar.

The *maxillæ* are broad, rounded at the base, curved round the lip, and moulded at the inner upper corner into a well-defined prominence; club-shaped spines are numerous across the base, and a few stretching up the lower part of the inner side. The *labium* is broader than long, hollowed in front, and has a thick cushion of spines extending from the inner edge to halfway down the front.

The *sternum* is as broad as long, truncate in front; the posterior sigilla, large and oval, are situated nearer to the median line than to the margin. It is only slightly convex and thickly covered with matted hair. The *legs* are rather equally stout, there being no difference between the first and fourth pairs. The scopulæ on all the tarsi are integral, on the metatarsi of the front two pairs they reach to the base, nearly so on the third pair, and halfway up on the fourth. There are no spines on any of the legs, but double bare streaks on patella and tibia i., ii., and iii., single on iv.

The *abdomen* is ovate, truncate, and narrowest anteriorly. The hairing is specially bright and silky in texture, of the same colour all over, above and below. The spinnerets are half the length of the cephalothorax, tapering from base to anterior end, the first joint longer than the third and both longer than the second.

The recurvature of the cephalic fovea is a generic character that cannot be ignored. It resembles *Selenocosmia stirlingi* in general appearance, but is otherwise readily distinguishable by the straightness of the rear row of eyes, the larger number of intermediate teeth in the falx-sheath, the lip more thickly bespined, and the last joint of the spinnerets shorter than the first.

One female from Palmerston. I have named the species after the sender, Mr. P. Foelsche.

Measurements in millimetres.

	Long.	Broad.
Cephalothorax ...	20	14 in front. / $17\frac{1}{2}$ in middle.
Abdomen	$29\frac{1}{2}$	$18\frac{1}{2}$
Mandibles	12 total length.	
,, ...	$7\frac{1}{2}$ horizontally.	
Fangs	8	
Spinnerets.........	$4\frac{1}{2}$, 2, $3\frac{1}{2}$ = 10.	
Inferior do.	$2\frac{1}{2}$, 2 diameters apart.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	10	18	18	16	=	62
	2.	9	16	16	16	=	57
	3.	7	15	15	16	=	53
	4.	$8\frac{1}{2}$	17	17	20	=	$62\frac{1}{2}$
Palpi		9	$13\frac{1}{2}$	$13\frac{1}{2}$	$7\frac{1}{2}$	=	$43\frac{1}{2}$

Subfamily DIPLURINÆ.

Genus CHENISTONIA Hogg.

CHENISTONIA TEPPERI, nov. sp. (Plate XIII. fig. 13.)

Cephalothorax dull red-brown (yellower brown in apparently rather younger specimens). Mandibles dark red-brown, with pale yellow downlying hairs and longer upstanding brown. Lip, maxillæ, sternum, and coxæ dark red-brown, with upstanding brown hairs only.

Legs and palpi paler red-brown, with long brown hairs, scopulæ yellowish grey.

Abdomen yellow above and below, with short downlying, almost golden hairs and a few longer and browner. The *cephalothorax* is nearly one-fifth longer than broad, slightly rounded at sides, a third part narrower in the front and rear than in the middle, and rising in a moderate slope from in front of a straight thoracic fovea two-thirds of the length of the cephalothorax from the anterior end.

The eye-space is on a somewhat rectangular raised prominence, which begins at a distance the diameter of the front middle eyes away from the margin of the clypeus. The front row of *eyes* is slightly procurved. The median pair, barely their diameter apart and only one-third from the nearest point of the laterals, are two-thirds the diameter of the latter, and stand on black shiny rings. The rear laterals, as far from the front laterals as the latter from the front median, are only slightly larger than the front median. The rear medians nearly touching the laterals are about as long as the front median, half their diameter from them; the rear row is distinctly recurved.

The *mandibles* are stout and rather longer perpendicularly than they are horizontally, the bristles on the fore part distinctly hardened, the fangs long and well curved. A row of eight large teeth on the inner edge of the falx-sheath and five small in the intermediate space at the lower end. The *lip* is slightly broader than long, hollowed in front and without spines. The *maxillæ* have a rather broad rounded base, are hollowed round the lip, and straight in front. They are thickly covered with spines over half the breadth of the basal area.

The *sternum* is a broad oval, slightly convex, and having the sigilla all marginal. The *legs* are moderately long and stout; the tarsi of all four pairs have a thick scopula, as also the metatarsi of the front two pairs. None of the tarsi but all the metatarsi are bespined, and two pairs of short spines on patella iii. All the patellæ have a broad longitudinal bare streak. The superior tarsal claws have about 8 or 10 pectinations in each of their two rows. The third claw short and bare and nearly straight.

The *abdomen* is oval, thickly covered with short furry hair intermixed with a few long single ones. The inferior spinnerets are close together. The superior, tapering from the base, are one

third the length of the cephalothorax, the third joint being rather longer than the first and the second shortest.

Five females from Ardrossan, Kangaroo Island, Burnside, and Blakiston, I have named after Mr. Tepper, who has collected them from several of the localities.

Measurements in millimetres.

	Long.	Broad.
Cephalothorax ...	12	$6\frac{1}{2}$ in front. $9\frac{1}{2}$
Abdomen	13	8
Mandibles	$7\frac{1}{2}$	
"	4 horizontally.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	5	10	11	$9\frac{1}{2}$	=	$35\frac{1}{2}$
	2.	5	10	10	9	=	34
	3.	$4\frac{1}{2}$	9	9	10	=	$32\frac{1}{2}$
	4.	$4\frac{1}{2}$	11	11	12	=	$38\frac{1}{2}$
Palpi		5	8	7	5	=	25

Superior spinnerets...... $1\frac{1}{2}$, 1, $1\frac{3}{4} = 4\frac{1}{4}$.

DEKANA, nov. gen.

Dekana, allied to *Chenistonia* by the almost unique position of the tibial palpal spur of the male, differs from the latter in having the thoracic fovea procurved and the posterior sternal sigilla rather large and removed from the margin by a distance equal to that from the median line.

Type species, *D. diversicolor*.

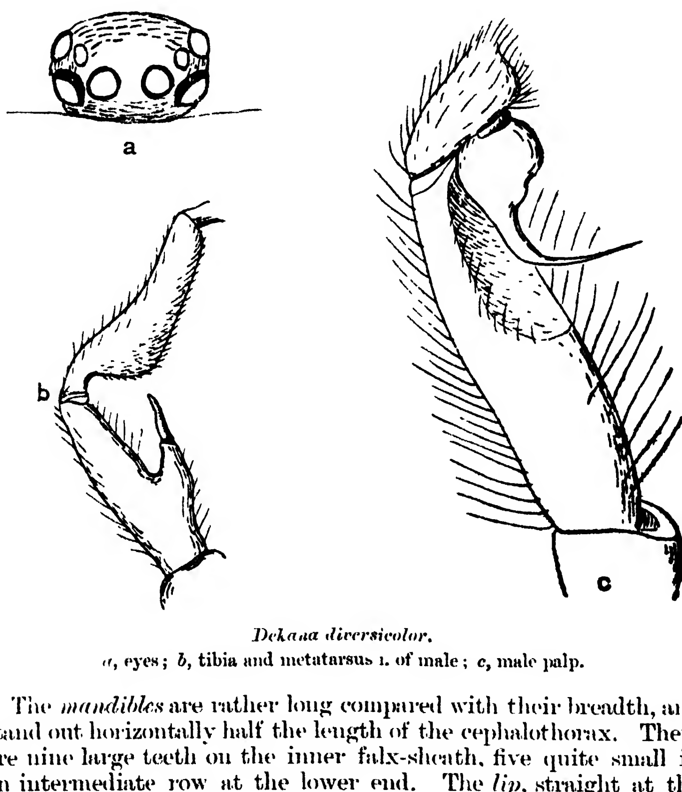
DEKANA DIVERSICOLOR, nov. sp. (Text-fig. 27.)

Male. Cephalothorax dark red-brown, mandibles black-brown, short fine downlying hair silvery white, and upstanding longer brown. Lip, maxillæ, sternum, and coxæ pale chestnut. Legs and palpi red-brown, lightening towards the extremities, scopulæ greyish yellow. Abdomen black above and underneath. Front abdominal shield, gill-covers, and spinnerets yellow, hairing silver-grey above, yellow on sides and underneath.

The *cephalothorax* is 2 millimetres longer than broad, rounded at sides, broadly truncate in front, somewhat narrower at rear end, which is concave. The cephalic part is only moderately raised up, the highest part being about the middle behind the eyes, which are situated on a well-developed oval prominence rising abruptly from almost the margin of the clypeus. The front middle *eyes*, green, the remainder being yellow, are three-fourths of their diameter apart and half that distance from the nearest point of the laterals which are $1\frac{1}{4}$ their diameter. These are set in a plane perpendicular to the cephalic surface, and being at the lower part of the prominence make the row, which is straight seen from above, rather strongly procurved from in front.

The rear row is recurved, the laterals half their diameter from those of the front row are the same in length as the front median. The somewhat square rear median are two-thirds the diameter of the laterals, nearly close up to the latter and half their diameter from the front median. The eye-space is 18 × 7, the whole prominence 18 × 10. The cephalic fovea is lunate and very clearly procurved.

Text-fig. 27.



Dekana diversicolor.

a, eyes; *b*, tibia and metatarsus I. of male; *c*, male palp.

The *mandibles* are rather long compared with their breadth, and stand out horizontally half the length of the cephalothorax. There are nine large teeth on the inner falx-sheath, five quite small in an intermediate row at the lower end. The *lip*, straight at the sides, hollowed in front, is broader than long and has one spine only visible about the middle.

The *maxillæ* convex at the base over half their width are thence hollowed round the lip and are straight in front. They are somewhat sparsely bespined over the whole basal area. The *sternum* is ovate, straight in front, broadest at rear, slightly convex. The posterior sternal sigilla are long and narrow halfway between the margin and the median line. The *legs* are only moderately stout, the tarsi being all scopulated and without spines; the metatarsi are all bespined, those of the front two pairs scopulated, and the

anterior end of the two rear pairs. The metatarsus of the front pair, characteristically protuberant on the under side, springs from a narrow base, and that of the second pair is also distinctly curved.

The tibial spur is rather nearer to the base than to the front end and quite as well formed as in *Chenistonia maculata.* The superior tarsal claws are pectinated in two rows of about nine teeth in each. The third short and bare.

As in *Chenistonia* the metatarsal joint of the *palpi* is somewhat long, and cut straight across the end. The stigma is curved and finely pointed, slightly longer than the palpal bulb. The *abdomen* is oval, rather long and narrow, the yellow chitinous shield and gill-coverings being very prominent on the black ground as also the spinnerets. The inferior pair of spinnerets are well developed, $1\frac{1}{2}$ diameters apart at the base. The first joint of the superior pair is $1\frac{1}{2}$ times the length of the second, the third being unfortunately destroyed.

One male only from Deka Station, near Blackhall.

Measurements in millimetres.

	Long.	Broad.
Cephalothorax ...	9	5 in front. 7
Abdomen	8	5 .
Mandibles	$6\frac{1}{2}$	
,, ...	$4\frac{1}{2}$ horizontally.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	$4\frac{1}{2}$	8	9	8	=	$29\frac{1}{2}$
	2.	4	8	$7\frac{1}{2}$	8	=	$27\frac{1}{2}$
	3.	$3\frac{1}{2}$	$6\frac{1}{2}$	$6\frac{1}{2}$	8	=	$24\frac{1}{2}$
	4.	$3\frac{1}{2}$	9	9	10	=	$31\frac{1}{2}$
Palpi		4	7	7	$2\frac{1}{2}$	=	$20\frac{1}{2}$
Superior spinnerets......		$1\frac{1}{2}$, 1, - - .					

Genus Aname L. Koch.

Aname tasmanica, nov. sp. (Plate XIII. fig. 12.)

Female. Cephalothorax, mandibles, lip, maxillæ, sternum, legs, and palpi a rather dingy yellow-brown, in most parts sparsely clothed with long upstanding dark brown hairs. The abdomen is a dingy greyish yellow, with short fine downlying yellow hairs interspersed on upper side, with long thin upstanding bristles on round roots. Spinnerets and gill-covers yellow; front median eyes deep orange, with black centres on black rims, other eyes pale yellow.

The *cephalothorax* is two millimetres longer than broad, slightly raised from in front of the thoracic fovea, which is procurved, about equally narrowed at front and rear.

The *eyes* are on a well-raised tubercle, the breadth of the front median eyes from the margin of the clypeus. The front row is straight, or from in front slightly procurved, the median pair three-fourths of their diameter apart. The laterals one-half that

distance away are one-third larger. The rear row is recurved. The laterals, touching the front laterals, are the same diameter as the front median, the oval rear median, two-thirds same diameter, almost touch the side, and are half the diameter of the front median away from them. The eye-space is 15 × 7, the tubercle 15 × 11 $\frac{\text{mm.}}{10}$.

The *mandibles* are horizontally slightly less than half the length of the cephalothorax. They have seven large teeth on inner margin of the falx-sheath and no intermediate. The *lip* is convex, somewhat broader than long, hollowed in front and without spines.

The *maxillæ* are straight in front, broadly rounded at base and profusely bespined over the whole basal area. The *sternum* is broadly oval, truncate in front, the posterior sigilla removed from the margin.

The *legs* are moderately stout, the tarsi of the front two pairs being scopulated and the metatarsi of the same partially so as well. On the third pair of tarsi is a faint indication of a scopula below the bristles. None of the tarsi are bespined, but all metatarsi and patellæ. The superior tarsal claws are pectinated in two rows with about seven to nine teeth in each. The superior claw is bare and very small. There are spines in a scopula on the metatarsal joint of the female palpi. The *abdomen* is oval, with thin downlying hairs and fine bristles on the upper surface.

The superior *spinnerets* are half the length of the cephalothorax, tapering, the first and third joints each about twice the length of the second. The inferior are 1½ diameters apart.

This species is easily distinguishable from *A. pallida* L. Koch, of which the front median eyes are also near together, by having no median or side stripes on the abdomen, and from my *A. grisea* by its much larger size, smaller rear eyes, and more compact eye-space, besides the falx-teeth, tarsal claws, and patellar spines.

One female from Table Cape, north coast of Tasmania, collected by Mr. Dove.

Measurements in millimetres.

	Long.	Broad.
Cephalothorax ...	10	{ 5 in front. 8
Abdomen	12	8
Mandibles	6½	
"	4½ horizontally.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	5	9	9	8	=	31
	2.	4½	8	8	8	=	28½
	3.	4	7	7	9	=	27
	4.	4½	9	9	10	=	32½
Palpi		5	6	6	4	=	21
Superior spinnerets......		2, 1, 2 = 5.					

EXPLANATION OF PLATE XIII.

Fig. 1. Eyes (× 10) of *Blakistonia aurea*, ♂, p. 133.
2. " " " " ♀, p. 132.
3. " " *Aganippe pulleinei*, ♂, p. 128.
4. " " " " ♀.
5. " " " *latior*, p. 126.
6. " " " *subtristis*, p. 126.
7. " " " *smeatoni*, p. 126.
8. " " *Idiosoma sigillatum*, p. 125.
9. " " *Anidiops manstridgei*, p. 125.
10. " " *Dyarcyops andrewsi*, p. 130.
11. " " *Arbanitis gilliesii*, p. 125.
12. " " *Aname tasmanica*, p. 140.
13. " " *Chenistonia tepperi*, p. 137.

June 17, 1902.

Prof. G. B. Howes, D.Sc., LL.D., F.R.S., Vice-President, in the Chair

The Secretary read the following report on the additions to the Society's Menagerie during the month of May 1902:—

The registered additions to the Society's Menagerie during the month of May 1902 were 141 in number. Of these 26 were acquired by presentation and 64 by purchase, 6 were born in the Gardens, 44 were received on deposit, and 1 in exchange. The total number of departures during the same period, by death and removals, was 131.

Amongst the additions attention may be specially directed to:

1. A fine example of the scarce and little-known Southern Anaconda (*Eunectes notæus* Cope) from Paraguay, deposited by the Hon. Walter Rothschild, F.Z.S., May 2nd, new to the Collection.

2. A female Hartebeest from Angola, acquired by purchase May 13th, apparently not different from the species of the Cape Colony, *Bubalis caama*.

3. Six Ruddy Flamingos (*Phœnicopterus ruber*) from Cuba, purchased May 29th.

4. Three American Bisons (*Bison americanus*) from the Woburn Herd, presented by the President of the Society, and received May 31st.

Mr. Oscar Neumann exhibited some specimens of Monkeys (*Cercopithecus*) and Hyraxes (*Procavia*), belonging to species discovered during his recent journey through North-east Africa and during his earlier journey through German and British East Africa. Among the Hyraxes exhibited were examples of *Procavia erlangeri*, the black-headed Hyrax from Harar and the sources of the Wabbi, *Procavia matschiei* from the south coast of Lake Victoria, and *Procavia* (*Heterohyrax*) *thomasi* from Kaffa and

Gimirra, this being a true *Heterohyrax*, but living in the trees like a *Dendrohyrax*.

Mr. Neumann remarked that he could not quite agree with Mr. Thomas in uniting all the large-toothed Hyraxes of Abyssinia (except *P. scioana*) under the name *Procavia abyssinica* Hempr. & Ehr. This latter was a form with a variable black spot on the back, living in Bogosland and in the coast-region of Erythrea. *Hyrax alpini* Gray and *Hyrax irroratus* var. *luteogaster* Gray seemed to be synonyms of this species, both coming from Northern Abyssinia.

There was also a form with a small but distinct yellow spot on the back, which should bear the name *Procavia ferruginea* (Gray). The type of this species had been obtained by Jesse in Northern Abyssinia, and four specimens of it, collected by Blanford in Adigrat, were in the British Museum.

The form of large-toothed Hyrax, which Mr. Neumann had previously thought to be *Procavia alpini* Gray (Mitteil. Ges. naturf. Fr. 1901, p. 241), therefore, needed a new name, and he proposed to call it *Procavia meneliki*. It was similar to *Procavia mackinderi* Thos., from Kenia, but smaller, apparently lighter, and with a very large yellow spot on the back. The head was lighter, and the outsides of the hind legs were far lighter than in *P. mackinderi*. From *P. jacksoni* Thos., from Mau, which it resembled in size, it was also distinguishable by its lighter colour and much lighter underfur. There were likewise differences in the skull, which would be mentioned in another place. It was met with in Abuje and Badattino, Province of Gindeberat, south of the Blue Nile.

Another species of Hyrax new to science was *Procavia* (*Dendrohyrax*) *ruwenzorii*, similar to *Dendrohyrax stuhlmanni* Matsch., and to *Dendrohyrax crawshayi* Thos.; but differing from the former in the pale grey instead of black underfur, and from the latter in the absence of any reddish in the general coloration. It differed from both of them in the long and thick fur, which was the softest and thickest of all the Hyraxes as yet known, and in the exceptional amount of long and woolly hairs standing out beyond the other fur.

The only specimen of this new species, collected by Sir Harry Johnston, in September 1899, on Mount Ruwenzori at an altitude of 11,000-11,5000 feet, was now in the British Museum (B. M. 1.8.9.43). It had been mentioned in Mr. Thomas's paper on the Johnston collection (P. Z. S. 1900, p. 178) under the name *Procavia crawshayi*.

The Monkeys exhibited by Mr. Neumann were *Cercopithecus hilgerti*, from the sources of the Wabbi; *Cercopithecus matschiei*, a very red form, from Kaffa; and *Cercopithecus djamdjamensis*, a mountain-form with very thick fur and a short tail, which lived at an altitude of from 10,000 to 12,000 feet in the bamboo-forests of Djamdjam, east of Lake Abaja. All these three species belonged to the *Chlorocebus* group.

Mr. Neumann also described a new species of the group of *C. albogularis* to which, at the suggestion of Mr. A. H. Neumann, the collector of the first specimen, he was glad to give the name *Cercopithecus kolbi*, in honour of Dr. George Kolb, the lamented German zoologist and explorer of the regions north-east of Mt. Kenia, who had been killed by a rhinoceros in 1899.

The following was the description of *C. kolbi*:—

♂. Similar in most respects to the dark mountain-form of *C. albogularis*, but with a pure white throat, which extends as a white half-collar round the neck, and leaves only a narrow space, about two inches wide, connecting the dark colour of the head with that of the back. The ears are thickly haired and pure white. The arms and hands are glossy black, the hind legs dark grey, the feet glossy black; the tail at the base is of the colour of the back, gradually passing into shining black towards the tip.

♀. Smaller, all the colours paler, head darker, the back more olive-brown, with less red; arms, hands, and hind feet paler black.

Five specimens of this species were in the British Museum.

The type (No. 0.1.31) had been obtained by C. S. Betton on the Kedong Escarpment, Sept. 21, 1899. Two other males had been procured by A. H. Neumann at 8000–9000 feet, on the east side of Mt. Kenia, and by Lord Delamere in Roromo, British East Africa. Two females had been obtained by Mackinder in the Nairobi forest on July 14, 1899. This species seemed to be restricted to Mt. Kenia and to the neighbouring mountain-chains.

Cercopithecus albotorquatus of Thomas, with which this Monkey had been confounded, was distinguished by its shorter fur—being probably a lowland form,—by the absence of the striking white colour of the ears, by its red anal region and base of the tail, by its reddish hind legs, and by the very sharp definition of the dark and white areas on the neck.

Mr. R. I. Pocock, F.Z.S., exhibited and made remarks upon the nest of a Gregarious Spider (*Stegodyphus dumicola*), sent home by Capt. Barrett-Hamilton, F.Z.S., from Vredefort Road, Orange River Colony, S. Africa.

A communication from Mr. H. J. Elwes, F.R.S., F.Z.S., called attention to the supposed new species of Elk from Siberia, published in the Society's 'Proceedings' for 1902 (vol. i. p. 207) and proposed to be called *Alces bedfordiæ*, no exact locality being given. Mr. Elwes stated that when he was in the Altai Mountains, three years ago, he had procured from Lake Teletskoi the skull and horns of an Elk which were so exactly of the character of those found in European Russia, that he could not distinguish them. They were well palmated with about twelve points on each side. Mr. Elwes was convinced that though there might be many local

variations in the Elk in various parts of Siberia, it was most unwise to assume on such slight evidence that non-palmation was a constant character of even subspecific value.

The following papers were read:—

1. Certain Habits of Animals traced in the Arrangement of their Hair. By Walter Kidd, M.D., F.Z.S.

[Received May 15, 1902.]

(Text-figures 28–31.)

The subject now considered is limited by two conditions—first, that only mammals with somewhat short hair can be studied; and, secondly, that only two groups of habits are of sufficient prevalence to bear upon the question.

The bulk of the animals to be dealt with belong to the two great orders of Ungulates and Carnivores. A few Simiadæ will be referred to, but other short-haired animals, such as Marsupials and Rodents, do not lend themselves to this form of study.

Certain of the habits common to all animals are divided into Passive and Active. The former include those concerned with the recumbent and the sitting positions, and the latter mainly those of locomotion, with a few subordinate ones.

I. *Passive.* (a) *Recumbent Position.*—The Ungulate, of which one of the Bovidæ may be taken as a type, adopts as its normal attitude in rest only that of lying prone; and such an animal lies with head raised, either at or above the level of its trunk, fore-limbs doubled so that the carpal joint is completely flexed, the hoof of one side slightly everted, and that of the other, as a rule, under the abdomen. The posterior portion of the thorax and the abdomen rest on the ground, but the pectoral region is raised by the fore-limbs so as not to be in contact with it. The hinder portion of the body of the Ungulate seldom lies in the median plane, but inclined to one side or the other, so that the lumbar and lower dorsal portions of the spine are rotated, and this causes the hind-limbs to be on one side, the metatarsal bones extended and in contact with the ground, the "knee" of the animal strongly flexed and closely applied to the inguinal region.

In the attitude of complete rest, during sleep, the Ungulate seems to lie in no constant attitude, stretched out on one or other side.

A typical and predominant attitude adopted by Carnivores in lying is that the animal, *e. g.* a fox-terrier, when in a state of partial rest, lies with its head elevated; or in complete rest, with head reposing on the fore-limbs, the ventral surface of the muzzle in contact with the flexor surface of the radius and ulna. The fore-limbs, in the case of the Carnivores, are planted in an

extended position, in marked contrast with the flexed one of the Ungulates. Thus it happens that the extensor surface of the Carnivore fore-limb lies on the ground, the corresponding surface of the Ungulate being in contact with the flexor surface of the metacarpus. There are occasions when a Carnivore, such as a domestic cat or dog, doubles up its fore-limb and lies as an Ungulate does; but this is far from the common habit, and the limb being relatively short, the surfaces in contact are not large.

This predominant habit of the Carnivores brings to pass a close contact of the flexor surface of the radius and ulna of each side with the pectoral region. Passing backwards, we find that the projecting thorax and upper part of the abdomen are in contact with the supporting surface, as in the case of the Ungulate. The hinder portion of the Carnivore shows much the same attitude as the Ungulate, but it is rather less rotated, and frequently the hind-limbs lie extended under the abdomen in the long axis of the trunk.

(*b*) It is hardly too much to say that an Ungulate never sits, and that, in the case of the Carnivores, this attitude in rest is only found with any frequency in the short-bodied forms. In illustration of this, one may point out that it is hardly to be conceived that a horse, ox, or deer could sit, and that, to take examples among domesticated Canidæ, a dachshund comparatively seldom sits, and that a fox-terrier or pug spends a large proportion of its time in a sitting posture. Such facts are of course explicable on purely mechanical principles.

As to the ætiology of the difference of attitudes adopted by the Carnivores and Ungulates, the general shape of the different types will to a great extent account for it. The Ungulate forms, generally speaking, have a short body, long legs, very sloping humerus in standing, and a very strong ligamentum nuchæ; whereas the Carnivore forms have a relatively long body and short legs, humerus more nearly vertical than that of the Ungulate, and an unimportant ligamentum nuchæ.

Of these divergent modifications of forms, I would suggest that the presence of a powerful and efficient suspensory ligament in long-necked Ungulates, attached to the neural spines of the cervical vertebræ, and to the heavy large head, which in many forms bears the additional weight of antlers, is the factor which mainly determines the Ungulate attitude. This ligament of course allows the Ungulate to maintain the level or elevated position of its head without muscular effort—a position which is greatly more adapted to the general shape of the fore-quarter and the "set" of the head of Ungulates than that of the Carnivore, with the under surface of the lower jaw resting on the ground. The ligamentum nuchæ of the Ungulate allows the centre of gravity of the heavy Ungulate fore-end to be thrown further back than is possible with the Carnivore. The effect of the Carnivore's attitude is to produce a forward slide of the fore-end on the extensor surface of the radius and ulna, where the subcutaneous

tissue is very loose, a slide which obviously is impossible in the strongly-flexed position of the corresponding joint of the Ungulate.

Among Simiadæ numerous groups adopt a corresponding habitual attitude of the forearm; and in Man the habit of resting this surface against supporting objects is very common, producing in both cases a similar forward slide.

II. *Active Habits.*—The most noticeable active habits of animals are those of locomotion. A few other habits, of a more varying character and less constantly present, will be noted under the different areas involved by them. The habits of locomotion vary in all degrees, from the short step and slow walk of a domestic ass to the amble of a horse, the quick, short trot of an ass, the full trot, canter, and gallop of a horse or other large Ungulate. The locomotive habits of the Carnivores are not so noteworthy, and their greater development of the fore-quarters than of the hind-quarters is noteworthy, the fore-limb being largely modified as a weapon of offence in addition to its locomotive function. The various animals which are now under consideration, with the exception of the Domestic Horse, exercise their locomotive powers according to their *own* needs. The Horse and its congeners, the Ass and Mule, stand alone in this respect; the Horse most conspicuously so, for this animal has been produced by man for locomotion just as much, though by different methods, as a locomotive engine has been produced—in each case for the benefit of man himself. The Horse has no other *raison d'être*. In this view, then, the Domestic Horse should be the most profitable of all animals for study under this division of the subject, and it is found to be so.

HAIR-DIRECTION.—The foregoing habits of animals, passive and active, are closely related to and shown by certain directions of their hairy coverings, and the latter often point out very clearly both what the animals have done and what they have not done. The direction of the hair may be loosely compared to a cinematograph representation of the life of the animal possessing it.

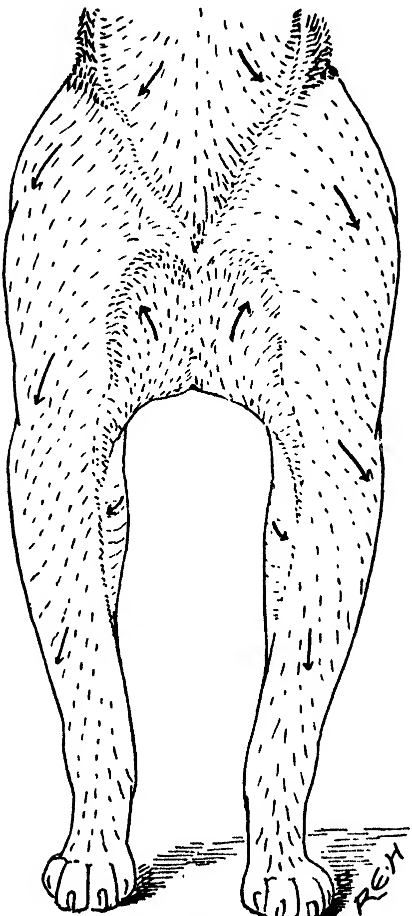
A. *Passive Habits.*—The passive habits of an animal in sitting and lying are necessarily shown mainly on the ventral surface of the body. The traces of their habits will be looked for in (1st) the pectoral region, (2nd) the fore-limb, (3rd) the abdomen, (4th) the extensor surface of the hind-limbs, (5th) the gluteal region.

(1) In the *Pectoral region* among Carnivores there is seen a marked impression, which corresponds with the pressure of the flexor surface of the fore-limb as far as this comes in contact with it in lying; and the result is that an area of hair is directed forwards against the general stream of the chest (text-fig. 28, p. 148). This is well shown in an ancient sculpture of two Molossian hounds in the Capitol Museum in Rome. In Ungulates this reversed area of hair is also common, but numerous exceptions have been shown to exist[1]. In the Domestic Horse this pectoral arrangement is more

[1] Proc. Zool. Soc. 1900, p. 686.

marked than in any other animal and quite constant; and it is probable that in this instance the arrangement of hair has a different mechanical cause, namely, a dynamical one. The attitude of the horse in rest does not lend itself markedly to the

Text-fig. 28.



Dog, showing the opposing hair-streams on the chest.

production of this arrangement; but the constantly locomotive life of the horse does afford adequate reason for a reverse direction of the hair-stream by means of strongly divergent traction of underlying muscles. It is interesting to compare this

whorl, feathering, and crest of the pectoral region of a Horse with what is found in the closely-allied Ass and Mule. In the Horse it is large, symmetrical, never absent, especially marked in high-stepping horses, whether cart-horses, or horses selected because of their high action in trotting. Its size, indeed, is a measure of the activity of the pectoral muscles and flexors of the fore-limb. In the Ass it is either absent (and this is the rule) or, when present, it is rudimentary; in the Mule it is more frequently present than in the Ass but still rudimentary. These degrees of development of the pectoral whorl, feathering, and crest in Horse, Ass, and Mule correspond closely with the locomotive habits of the three animals.

In the six Prejevalsky's Wild Horses in the Society's Gardens it is also absent, as one would expect in a wild animal. In Zebras and *Equus asinus*, though so closely allied in form to the Horse, but so unlike in their wild and *independently* locomotive life, it is absent.

(2) On the *Fore limb* the two types of arrangement of hair have been fully described [1] elsewhere, and it is only necessary to point out here their relation to the two main recumbent attitudes, those of the Carnivore and the Ungulate; the exceptions found among the latter have been given elsewhere [2].

(3) *Abdomen.*—The ventral surface of the thorax and abdomen show little interference with the normal slope of the animal's hair caused by its attitudes in lying. It is perhaps not unnecessary to point out this fact, because in such a study negative facts may weigh considerably in support of a positive contention if explanations in accordance with these be forthcoming. When lying on the ventral surface of its abdomen, an animal rests very little on the thorax because of the support of the fore-limbs; and in this position any tendency to slide forwards which may exist serves but to confirm the normal slope of hair from cephalic to caudal extremity, and thus the absence of any marks on the ventral surface, due to the recumbent position, is fully accounted for.

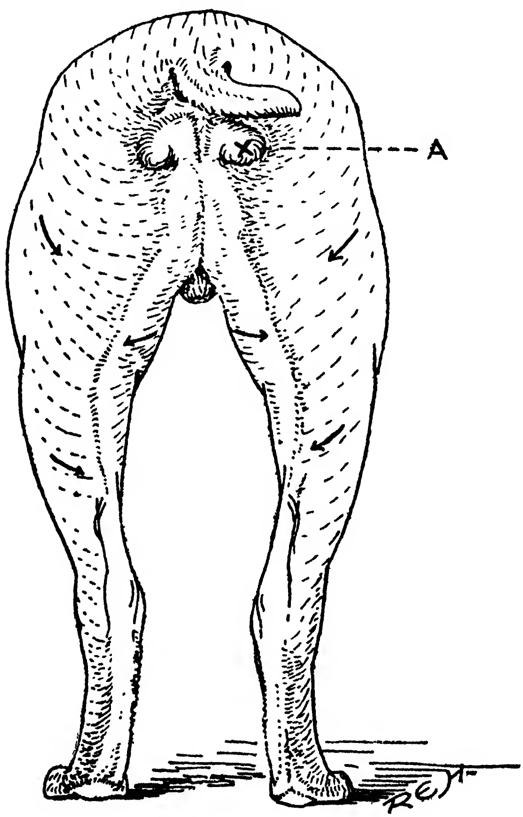
On the lateral aspect of the abdomen there is found in nearly all Carnivores and Ungulates an area of reversed hair, where the "knee" of the animal rests in flexion, during lying and sitting, against the flank. The extent of this area is variable and is usually marked off by a margin, showing where the general backward and downward direction of hair on the flank is interrupted by the pressure of the flexed hind-limbs. In many animals, there is a general forward slope of the hair on the hypogastric region till it reaches a point on the abdomen where apparently the effect of the pressure of the hind-limbs ceases, and at this point a tuft is often seen, especially in horses. It is shaped very much like a small stack of corn, and stands out from the rest of the surrounding hair. I have seen a definite ridge with two tufts at the meeting-place of the stream of hair from the thorax and

[1] 'Use-Inheritance,' A. & C. Black, 1901, pp. 28, 29.
[2] Proc. Zool. Soc. 1900, p. 686.

abdomen with that which passes forwards from the inguinal region; and such hereditary tufts are most difficult to account for, except on the supposition that the slowly-growing trunk-stream is opposed and interrupted by the reverse action of the flexed hind-limbs in the recumbent position, pressing against the flank.

(4) The *Gluteal* region is the only one where the posture of sitting is indicated in the arrangement of hair (text-fig. 29). It is obvious

Text-fig. 29.



Dog, showing the whorl (A) on the gluteal region and hair-streams on the extensor aspect of the thigh.

that, except for pressure on the digits of the fore-feet and on the metatarsal bones, there is no point of contact of the body with the ground, except the tubera ischii. Here is the very spot in animals, accustomed much to the sitting posture, where a whorl lies exactly over the tuber ischii of each side; and it is a breach of

the "law of parsimony" to look for any other cause of this whorl than the pressure of the weight of the animal's body on the hair over this prominent region.

In almost all the Carnivores and Ungulates, the hair on the gluteal region curves over this rounded surface, taking a course in the long axis of the limb itself, as in a horse, or very often in the long axis of the trunk, as may be seen in a short-haired dog. The sweep of this gluteal stream towards the perineum is interrupted by the whorl mentioned, in a few animals which sit, such as short-haired dogs and many of the Simiadæ, though in most of the latter it is rather a bare area or callosity than a whorl—but equally significant as to causation. In all such Ungulates as Bovidæ, Equidæ, Cervidæ, Ovidæ, *Capra*, Tapiridæ, and in Felidæ, Ursidæ, and most wild Canidæ—animals in which the sitting posture is either impossible, inconvenient, or little adopted—it is conspicuous by its absence.

(5) The posterior or extensor aspect of the *Femoral* region in many animals shows on its inner half the marks of pressure against the ground, in a reversed slope of hair which passes upwards and outwards to meet the downward and inward slope of the stream coming from the outer half of this limb-segment.

B. *Active Habits.*—The effects on the arrangement of hair of animals produced by active habits are shown mainly in the formation of whorls at certain critical points, with their associated featherings terminating in crests or ridges. The greater or less activity of locomotion is the most important fact about an animal in this respect; but three regions of the body present whorls which are not directly connected with locomotion, and these may be considered first. They are the *Nasal*, *Frontal*, and *Spinal* regions.

On the *Nasal* region the slope of hair varies in a remarkable degree in different animals, and has been considered elsewhere [1]. It is therefore only necessary to remark here that a nasal whorl and commencement of feathering is found very constantly close to the muzzles of those animals with long, pointed snouts, such as Canidæ and Cervidæ, and that in such as Felidæ, with broader snouts, it is found at the level of the orbits. Thus the slope of hair on the nasal region in the former is from snout to orbit, and on the latter from orbit to snout. This is obviously not a mere unaccountable correlation of facts, but a mechanical result of the shape and *pose* of the head, which thus confers on the narrow snout a backward, and the broad snout a forward and downward trend of hair, owing to constant friction in their respective directions. That this differing direction of hair is an adaptive modification produced for the benefit of the animal, cannot be seriously maintained.

In Tapirs the bilateral nasal whorl is situated in a very suggestive position, just where the large projecting snout begins to curve downwards.

[1] Proc. Zool. Soc. 1900, pp. 677–680.

Frontal.—The arrangement of hair here need not be stated at any length; it is sufficient to point out that a whorl is found at very different levels in varying forms of head, from a position low down almost on the nasal region, in the Domestic Ass, to a point near the level of the external ears, as in certain Bovidæ. A tolerably constant fact connected with it is that from it proceeds a feathering, which passes towards the ears and terminates in a crest. In this instance, as in others, the whorl indicates the commencement, and the crest the cessation of a very persistent and strong muscular action common to the life of the animal, effectively leaving an indelible mark on the hairy covering. This frontal whorl lies just over a group of muscles whose fibres pull in very divergent directions; and the crest is situated where the effect of the traction of the former muscles becomes neutralized by the opposing temporal muscles. The particular animal habit, indicated by these arrangements of hair, is most probably associated with the incessant action during numerous hours of the day spent, on the one hand, by the animal in feeding and cropping herbage, and on the other in active locomotion. All of these actions tend to employ powerfully the maxillaris muscle, or levator labii superioris et alæ nasi, which in the former raises the upper lip, and in the latter dilates the nostril. These actions of the maxillaris muscle are best observed in the browsing habits of Oxen and the locomotive habits of the Horse. Again, the Domestic Horse is useful for study in this matter, for its preponderating activity of locomotion agrees with the fact that this frontal whorl is more marked and persistent than in any other animal.

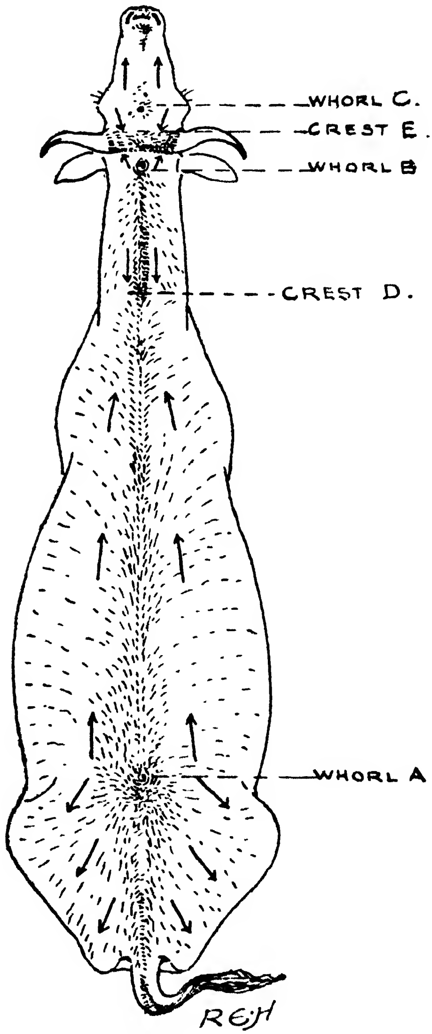
In the Horse this frontal whorl lies at the level of the orbits in the majority of cases; in the Domestic Ass so low down as to be on the nasal region as a rule; in the Mule it is situated midway between the positions of the Horse and Ass.

In all Zebras examined it has been found that the frontal whorl feathering and crest are singularly ill-developed, and even often absent. This difference in an animal so similar in form to a horse is peculiar, and probably is connected with the fact that though Zebras are capable of very active locomotion, they differ very materially from Horses in the general character of their lives, not being incessantly occupied in locomotion on behalf of man as the domestic horse has been since it was domesticated. Thus in wild Equidæ one very important action of the maxillaris muscle is *occasional* and much less strong than in the horse, and is also less strong than in the ass and mule.

The *Spinal* region in the middle line shows in the hair of certain animals, chiefly Ungulates, very varying results of their varying habits; and the simplest instance of these arrangements is to be seen in the view from above of the back of an Ox, or preferably a calf (text-fig. 30, p. 153), the young animal showing the points more clearly. In this view the parietal region of the extended head may also be examined. In the frontal region is seen the frontal

whorl—this is produced into a *feathering* which terminates in a *crest* just below the level of the horns. From this crest the

Text-fig. 30.



Domestic Ox (young): opposing hair-streams and whorls, seen from above. A, B, C, whorls; D, E, crests.

hair-stream passes backwards to a whorl below the ears. At the middle or posterior third of the neck, the backward stream of

the neck from this whorl is met by a forward stream, and a *crest* is produced by the two opposing streams. The forward stream from the trunk is a feathering which starts from a whorl situated about the middle of the dorsal region. In this view of the median plane there are seen three whorls, two crests, and at each of the latter two opposing streams of hair.

It seems hardly possible that these arrangements of hair and reversed slope in two separate areas can be connected with any other cause than muscular action, especially that of the panniculus carnosus, whose fibres here lie nearly in the long axis of the trunk with a slightly downward direction. It corresponds with the arrangements found on the back of other forms, such as the Lion, certain Antelopes, Bovidæ; and some with longitudinal and central crests or manes, as in *Connochætes* and *Oreas canna.*

Whorls and forward featherings in the spinal region are not very common, and would appear to be determined by the activity of the panniculus carnosus employed in defence of the animal against flies and various insects. This function is also subserved by the tail, so that an animal possessing an efficient tail, and presenting, in a spinal whorl and feathering, the evidence of a very active "fly-shaker," as it is popularly called, is well adapted for existing in areas where flies abound. It is worth noting that such animals as Cervidæ, Ovidæ, *Capra*, Gazelles, with few exceptions, present neither efficient tails nor this particular evidence in the hair of a very active "fly-shaker," but that many of the larger Antelopes, true Oxen, and Giraffes present both efficient tails and evidence of activity of this superficial muscle in whorls, featherings, and longitudinal crests or manes. Some of the most marked instances of spinal whorls and manes have been studied, and measurements taken from the root of the tail to the tip, and from the same point to the situation of the spinal whorl. These measurements of 17 species and 29 specimens are given, by which it is shown that animals which possess well-developed manes and spinal whorls and featherings also possess efficient tails, though the distance between the root and tip of tail, and root of tail and whorl or end of mane, in some forms, does not correspond closely, which one would hardly expect.

The species examined and the measurements were as follows.—

	From root to tip of tail.	From root of tail to spinal whorl or end of mane.
Connochætes gnu	32 inches.	29 inches.
" *taurinus*	24 "	28 "
Oryx gazella (2 specimens)	30 "	14 "
	31 "	14 "
" *beisa* (2 specimens)	26 "	15 "
	25 "	12½ "
Hippotragus niger	20 "	38 "
" *equinus*	25 "	36 "
Oryx beatrix	17 "	10 "

	From root to tip of tail.	From root of tail to spinal whorl or end of mane.
Cobus unctuosus	15 inches.	18 inches.
„ *kob*	12 „	23 „
„ *leche* (3 specimens)	12 „	25 „
	9 „	15 „
	9 „	15 „
„ *senegamus* (3 specimens)	$10\frac{1}{2}$ „	19 „
	$8\frac{1}{2}$ „	$16\frac{1}{2}$ „
	9 „	$12\frac{1}{2}$ „
„ *vardoni* (3 specimens)	$9\frac{1}{2}$ „	15 „
	9 „	19 „
	$5\frac{1}{2}$ „	8 „
„ *thomasi* (2 specimens)	$9\frac{1}{2}$ „	15 „
	13 „	20 „
„ *leucotis*	7 „	13 „
Cervicapra arundinum (3 specimens)	19 „	14 „
	12 „	17 „
	12 „	20 „
„ *fulvo-rufola* (2 specimens)	9 „	15 „
	8 „	12 „ (young)
Felis leo	37 „	20 „

In the (1) *cervical*, (2) *pectoral*, (3) *post-humeral* or *axillary*, and (4) *inguinal* regions, the changes of hair-slope consequent upon habits of active locomotion are most evident.

(1) In the lateral and ventral aspects of the neck, whorls are frequently seen in the Horse and seldom in other animals, and these are less uniform in position and degree of development than in other regions. In the strongly-developed muscular neck of a horse, they appear very frequently between the sterno-mastoid and splenius, or the sterno-mastoid and sterno-hyoid, and in the middle line of the ventral surface. *Felis leo* and *F. pardus* show very marked whorl and feathering on the side of the neck, probably from the strongly acting panniculus carnosus.

(2) The pectoral area is one of the "critical areas" from this dynamical point of view; and many animals exhibit here marked signs of the degree and range of their locomotive activity in more or less persistent whorls, feathering, and crests, lying over the situation where the strong and important pectoral and flexor muscles of the fore-limb diverge. It is unnecessary to mention in detail the various animals in which these appear more or less markedly[1]; but the cases of the Horse, Ass, and Mule may be more particularly considered, as bearing on the position here maintained, namely, that the range, degree, and constancy of muscular habit in the life-history of a species is portrayed in the hairy covering in certain parts of their bodies, where this is possible.

[1] See 'Use-Inheritance,' A. & C. Black, 1901, pp. 18, 19.

In the Horse a marked whorl, feathering, and crest are never absent from the pectoral region; a specimen that failed to show this would be an abnormality, and the arrangement peculiar to the horse is not only constantly present, but varies in width, length, and definition, according to the muscular development of the great masses of pectoral muscle, which are so active in flexion of the "elbow" of the animal. Indeed, it is roughly possible to determine by this criterion in individual cases whether this or that specimen and its immediate ancestors were high-stepping animals or the reverse.

The difference between the wide and long whorl, feathering, and crest on the pectoral region of a high-stepping, muscular English cart-horse, and the narrow, ill-developed arrangement, resembling that of a mule, on the corresponding part of a small, ill-bred, shambling hackney, such as are very common in Italy, is very striking in illustration of this point.

In the Domestic Ass, with its small pectoral development and short step, the whorl, feathering, and crest are seldom present at all, and most variable and rudimentary when they are present.

In the Mule, with somewhat stronger muscle and higher action, and yet in both respects far inferior to the Horse, the whorl, feathering, and crest are more marked and more often present than in the Ass.

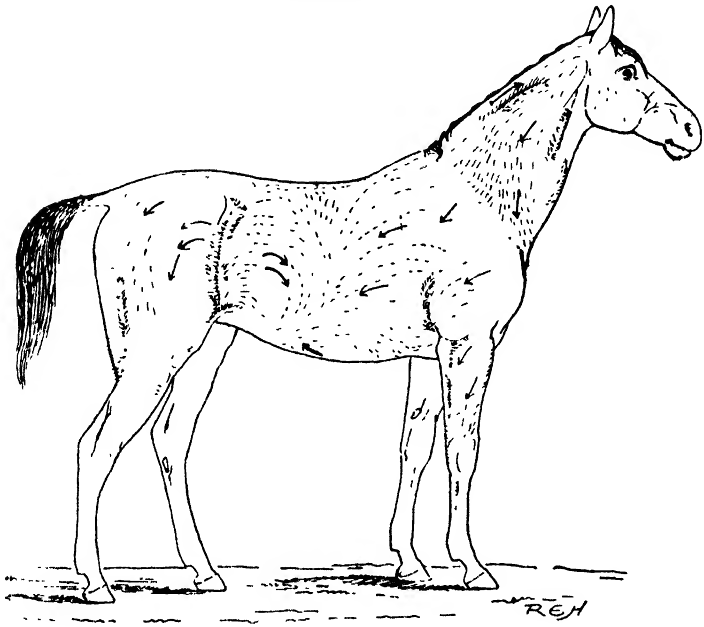
(3) The *post-humeral* or *axillary* region occasionally furnishes evidence of the locomotive activity of the animal and its ancestors; but the whorl, feathering, and crests found here are never constant in a large number of specimens and even in horses are rare, not more than 2 per cent. of our domestic horses showing it.

(4) In the *inguinal* hollow of many animals there are marked traces of their personal and ancestral activity. In the Horse, the well-known appearance of a graceful feathering, starting from a whorl at the inguinal fold of skin and passing up to a marked ridge at the level of the crest of the ilium, is as constant as the corresponding phenomenon in the pectoral area (text-fig. 31, p. 157). Here, again, a horse that did not present this feature would be an abnormality. It varies, as any other character may, in degree and fulness of development, and is an evidence of a certain portion of the anatomy and modern life-history of the species. The comparative anatomy of this arrangement has been elsewhere[1] more fully treated, and it is unnecessary now to allude to this, except in the case of the Horse, Ass, and Mule. In the Horse it is constant, well-developed, and the length of the feathering is never less than half the distance between the margin of the inguinal fold of skin and the crest of the ilium. In the Mule it is constant, but never larger than this minimum development of the horse; and in the Ass seldom present, and, when present, it is but a circular small whorl without any definite feathering or crest, and is situated at the centre of the ilio-inguinal hollow.

[1] P. Z. S. 1900, p. 686.

These degrees of development in three familiar animals are suggestive as to the well-known differences in their locomotive activity.

Text-fig. 31.



Domestic Horse, showing the hair-streams, feathering, and whorls.

It may be remarked that the Prejevalsky's Horses in the Society's Gardens exhibit small whorls, featherings, and crests, more like those occasionally found in the Ass than those of a Mule or Horse, and that no Zebras of the various species examined show any traces of this arrangement of hair; also that *Equus onager*, in the Society's Gardens, alone shows a large whorl, feathering, and crest, like those of a Mule, but wider and better developed.

One may now ask, after the review of these evidences as to the connection of the habits of animals with arrangements of hair, whether it is not shown that they carry about them clear traces of their habits, passive and active, which are peculiar to them and to a long line of ancestors.

In this view, whorls, featherings, and crests may be looked upon as by-products of muscular activity. If this be allowed, it is highly instructive to note what muscular activity is capable of doing, as to modifying the direction of hair, a structure itself not concerned in muscular action; and it is not less important from the point of view of inheritance to note that very long-continued

and constant pressure of harness, an influence not connected with the vital actions of the animal concerned, is incapable of producing any similar effects. The latter is fully in accord with the extensive study and negative results of the supposed inherited effects of mutilations.

Mr. Lydekker has pointed out the interesting opinion of Darwin, that the habit, displayed by domestic horses, of clearing away the snow from their pasture in winter by scraping with their front hoofs, indicates that the original habitat of the species was in regions where the ground is covered during a portion of the year with snow, so that this trait of the domestic horse, as we know it, would be looked upon as vestigial. In reference to many of the varieties of hair-arrangement here given in detail, it is hardly a less legitimate inference to hold that they present an epitome of long-continued and oft-repeated muscular activities in the line of ancestry involved, though themselves of no importance.

2. On the Carpal Organ in the Female *Hapalemur griseus*. By Frank E. Beddard, F.R.S., Vice-Secretary and Prosector of the Society.

[Received June 3, 1902.]

(Text-figures 32–35.)

Some years ago[1] I described and figured in the male *Hapalemur griseus* a patch of spine-like structures upon the forearm close to the wrist, which was associated with a gland lying beneath the integument of "about the size and shape of an almond." I figured this patch as lying just behind the wrist and separated from the callous integument of the palmar surface of the hand by a region covered with the ordinary body-fur. Later[2], this same structure was again recognized by Mr. Bland-Sutton and figured by him. Still later, I found myself able to add some further details with the help of a second specimen of a male of this Lemur[3]. I have not been able until the present time to examine a female of this species. Until this year, all the examples of this species acquired by the Society appear to have been males. But the death of a female example in May of this year enables me to complete the examination of this novel organ, by studying its characters in the female. I may remark, in the first place, that in my earliest paper upon *Hapalemur* I was able to quote from the late Prof. A. Milne-Edwards and from Dr. Jentink information to the effect that the patch of spines is not present in the female, but appeared to be represented by a tract of modified skin. Since then the arm of this species of Lemur has been figured by

[1] "On some Points in the Structure of *Hapalemur griseus*," P. Z. S. 1884, p. 391.
[2] "On the Arm-gland of the Lemurs," ibid. 1887, p. 369.
[3] "Additional Notes upon *Hapalemur griseus*," ibid. 1891, p. 449.

M. Milne-Edwards [1]; but the drawings which I herewith submit to the Society show rather more plainly certain points to which I now desire to call attention. At first sight the patch of integument in the female seems to present several differences of importance from the corresponding structure in the male animal. But the differences are not quite so great as might appear,

Text-fig. 32.

Lower surface of hand of *Hapalemur griseus*, ♂.

A, callous pad overlying arm-gland; B, patch of spines; C, tuft of long hair. (From P. Z. S. 1891, p. 450.)

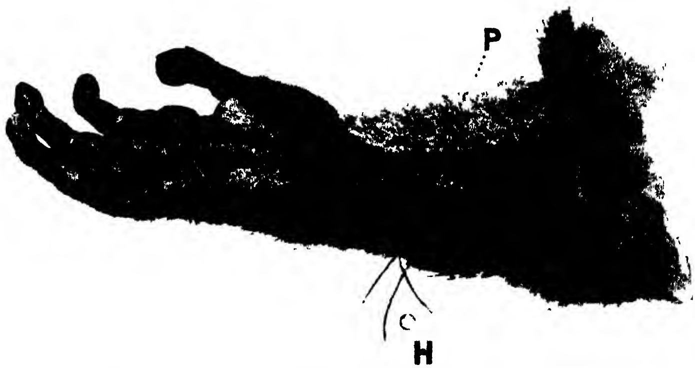
particularly if a dried skin only were examined. The callous patch extends for a distance of about two inches up the arm; on the wristward side it is continuous with the integument of the hand. This, it will be remembered, is also the case with the male,

[1] Histoire naturelle &c. de Madagascar, Mamm. Atlas, pl. 122 z. It is not quite clear whether the male or the female is intended; the illustration is a reproduction of a photograph and is not very good. In any case there are only two figures, one of the ventral and the other of the dorsal surface of the hand of the animal, and, presumably, the same hand. The corresponding text has not yet appeared.

though in my original figure I represented the patch of spines as ceasing some little way in front of the wrist—as was indeed the case with the specimen examined. The greater or less extent of the patch may be a question of age.

But in the second specimen examined by myself (text-fig. 32, p. 159) the patch of spines was quite continuous with the integument covering the palm of the hand. The patch, moreover, was not entirely covered with the longish, squarish, spine-like outgrowths; a small tract immediately covering the gland was covered with thickened and horny integument, but of a nature more resembling that upon the palm of the hand. In the female, as the accompanying drawing shows well (text-fig. 33), the tract of skin is of quite the same shape as that occurring in the male. But it is uniformly covered with low elevations of a rounded contour which are precisely like those which cover the palm of the hand, except upon the "balls" of the fingers, where the integument is marked

Text-fig. 33.



Palmar surface of hand and forearm of *Hapalemur griseus*, ♀.
H, carpal vibrissæ; P, horny patch.

with fine concentric grooves. The patch in fact appears to be merely an extension backwards of the callous integument of the palm of the hand. This is exactly the same thing that is met with in *Lemur catta*[1]. So far, therefore, there is a correspondence in the two sexes of *Hapalemur griseus*. And in reality the likeness goes still deeper. The spine-like outgrowths of the male are in all probability quite comparable to structures which I have lately described in the hind foot of *Galago garnetti*[2]. In this animal, a microscopical investigation of the spines shows that they are merely columnar outgrowths of the horny layer of the integument, and not special structures peculiar to the Lemur. They

[1] Bland-Sutton, *loc. cit.* p. 370, fig. 2, & p. 371, fig. 3.
[2] P. Z. S. 1901, vol. i. p. 271.

are simply intensified callous papillæ. I see no reason to doubt their histological similarity in *Hapalemur*, though I cannot from my own observations upon the actual specimens state this with absolute certainty. In this case, therefore, the male *Hapalemur griseus* is not characterized by any structure peculiar to its sex, but merely shows an exaggeration of the characters found in the female, a constant state of affairs in the secondary sexual characters of animals. If the elevations upon the carpal organ of the female were much increased, the characters of the male would be produced; and it will be remembered that a portion of the tract of integument in the male has preserved, at least in one specimen which I described, the characters of the integument in the female. The drawing to which I have referred shows also that the carpal vibrissæ are present in the female as well as in the male. It is but rarely that these hairs are absent in one sex and present in the other of a given species[1].

With regard to the external structure of the arm in this Lemur, I may finally observe that the naked patch of thickened integument is not absolutely devoid of ordinary hairs. In transverse sections a few of these are apparent. Here again we have a less modified state of affairs in the female than in the male.

In the male *Hapalemur griseus* I described the naked-eye characters only of a peculiar gland underlying the tract of modified

Text-fig. 34.

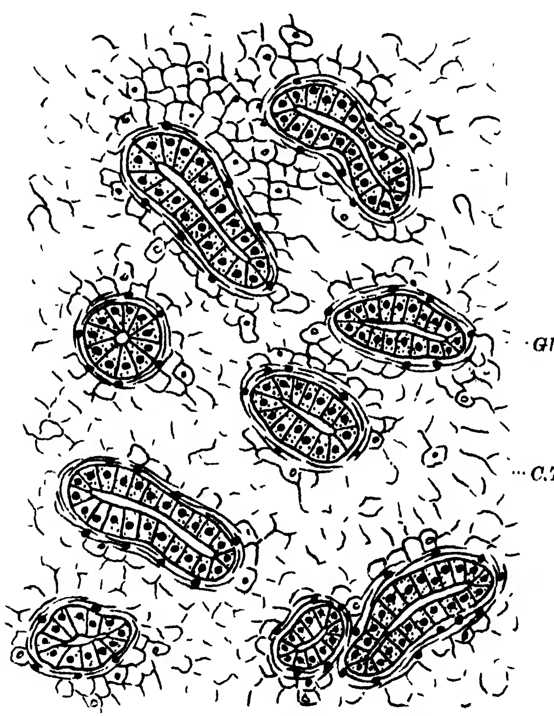
Palmar surface of hand and forearm of *Hapalemur griseus*, ♀.
The integument is reflected to show gland (G); other letters as in text-fig. 33

skin upon the arm. This gland was of a white colour and very conspicuous, lying immediately below the skin. I find that the female animal has precisely the same kind of gland (text-fig. 34), occupying the same position. It underlies, in fact, the callous integument.

[1] Beddard, 'Observations upon the Carpal Vibrissæ in Mammals," P. Z. S. 1902, vol. i. p. 127

It is of about three-quarters of an inch in length and less than half an inch in width, of an oval contour and white colour. Were it not for its regular shape and the lean condition of the animal, I should perhaps have put down this gland for a piece of fat, to which it bears a striking resemblance in general appearance and also in texture and "feel." It is very soft and could be readily scraped away; it was difficult to dissect it away cleanly from the skin before the whole area had been hardened in spirit. The reason for this resemblance to fat becomes plain when the tissue of the gland is examined microscopically. The accompanying drawing (text-fig. 35) shows a portion of a section through the

Text-fig. 35.



Transverse section through arm-gland of *Hapalemur griseus*. Highly magnified. *C.T*, connective tissue; *Gl*, glands.

gland, cut across the long axis. It will be observed that the chief portion of the gland is not formed of glandular tissue at all: it consists of a network of adenoid tissue which may very possibly here and there have held fat-cells in its meshes. It is extremely

like the reticular tissue of a lymphatic gland. The laxity of this tissue accounts for the fatty texture which the gland exhibited on dissection. Imbedded in this reticular mass are the tubes of the glands proper. The directions of these, as will be seen from the drawing referred to, is mainly across the short axis of the gland. They run, however, in various directions. The tubes are on the whole of much the same width throughout; but the calibre varies slightly from place to place. They are lined by a layer of low columnar epithelium, and outside of this is a layer of muscular fibres. The glandular tubes in fact conform to the plan of gland exhibited by the sweat-glands of mammals. They do not belong to the sebaceous type. The course is not straight or even approximately so; the glands are coiled in much the same way which characterizes other sudoriparous glands, and one can occasionally notice the characteristic undulations of these glands. I could not observe anywhere any evidence of the branching of the glands, and if it occurs it is at least not common; each separate tube appeared to be absolutely free of its neighbours. Nor could any common duct be observed by which the sum total of the separate glands opened on to the exterior. When a section across the arm-gland was examined by a low-power lens, the adenoid tissue was seen to be massed into strands lying to a considerable extent parallel like the leaves of a book; the direction of these strands was mainly in the same plane as the two lateral surfaces of the gland-mass and the two ends of the same. But the strands are not entirely unconnected with each other. A much thinner, laxer, tissue connected them to each other. But very frequently the thinness of this led to its being missed through injury or mere insignificance in a given section. It is in the thick plates only that the gland-tubes are to be seen; they do not occur in the much laxer between-tissue. The arm-gland, therefore, of this Lemur appears to present a possible stage in the evolution of a compound gland out of an aggregation of separate sudoriparous glands. It is very comparable to the milk-gland, only that that gland (save in the Monotremes) is an aggregation of sebaceous glands. If the laxer connective tissue lying between the thicker plates were to vanish, and the gland-tubes, being more closely approximated, acquire a connection with each other, a compound gland would result. The external appearance of the gland, as already stated, and as apparent in the drawing exhibited herewith (text-fig. 34, p. 161), is quite that of a compound gland, and does not at all suggest a merely close approximation of separate gland-tubes. The prevalence of the framework of the gland over the gland-tubes is a very striking feature of this arm-gland.

3. On a new Cœlomic Organ in an Earthworm. By Frank E. Beddard, M.A., F.R.S., and S. M. Fedarb.

[Received May 13, 1902.]

(Text-figures 36–39.)

The following observations relate to *Pheretima* (*Perichæta*) *posthuma*, and were made upon some well-preserved material from Calcutta which we owe to the kindness of Mr. F. Finn, F.Z.S., Deputy-Superintendent of the Indian Museum. In dissecting a number of these worms, a series of sac-like structures were plainly observable upon the floor of a certain number of segments in the middle of the body. The accompanying figure shows the general appearance of these when magnified by a hand-lens (text-fig. 36), from which it will be seen that the structures in question have the form of an hourglass, or a double cone with the bases of the two cones distant and their apices in contact. Ventrally, these sacs come near to the ventral nerve-cord; but dorsally they do not reach the opposite side of the body. They occupy in fact not more than a fourth or fifth of the total circumference of the body-wall. They are symmetrically disposed from segment to segment; that is to say, they occupy the same position exactly in consecutive segments. It is easy to see, merely with the use of a lens and a dissecting needle, that these structures are cavities formed by a membrane, which is anteriorly and posteriorly, but not laterally, attached to the parietes of the body. A needle can be readily slipped under the sac at each end. They may be said, in fact, to end laterally by a wide funnel-shaped mouth, the corners of which, as is shown in the drawing already referred to, are somewhat drawn out so as to offer a firmer basis of attachment, like the ropes of a tent. In the middle, the surface of these chambers is quite convex upwards; and at the "waist," where the two cones join by their apices, there is a considerable narrowing marked by the passage of a strong blood-vessel. These cavities are, however, not equally marked in all the specimens of this earthworm which we dissected; they are much more conspicuous in some than in others. We thought it possible to detect a relation between them and the glands attached to the septa just above the intestine—those small and also apparently cœlomic structures which one of us has described in several species of this genus of earthworms[1]. Where the glands lying above the intestine were well developed, it appeared to us that the ventral cœlomic chambers were also particularly conspicuous.

We do not, however, venture to insist upon any special relationship between these two series of organs. These pouches do not run continuously through the body of the worm. They begin behind the spermiducal glands at about segment xxii., and are seen to increase gradually in size up to as far back as segment xl. For about twenty segments they are at their prime. After this point they get smaller and often irregular; but they extend right to

[1] Beddard, P. Z. S. 1890, p. 61 ("Glycogenic organs")

the posterior end of the body. There are then about twenty pairs of these chambers which are fully developed. In the regions of the body where they are feebly developed, the pouches present the appearance shown in the accompanying drawing

Text-fig. 36.

Cœlomic pouches of *Pheretima posthuma*.
N, nerve-cord; O, orifices of pouches; S, intersegmental septum.

(text fig. 37). The two halves have come apart or, perhaps, rather have not joined—and where a single hourglass-shaped sac was to be seen are two smaller sacs of roughly conical form, separated by a considerable space. The fully developed sacs

measure 3 mm. from mouth to mouth, and their diameter is about 5 mm. This is all that we have to say respecting the naked-eye

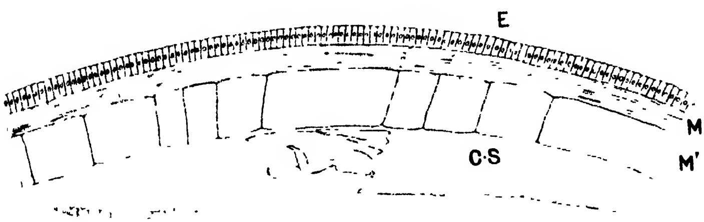
Text-fig. 37.

Imperfectly developed cœlomic pouches of *Pheretima posthuma*. Lettering as in text-fig. 36.

characteristics of these structures, which do not appear to have been noticed in this genus of earthworms, though we shall point

out later that there are somewhat similar cavities in, at any rate, one other genus of earthworms. The naked-eye features of these organs was not unsuggestive of "cœlomo-ducts"; they are plainly part of the cœlom still, opening into it by a wide mouth and narrowing towards an opposite extremity. Naturally, therefore, the existence of any orifice on to the exterior of the body was carefully sought for. We have satisfied ourselves, however, that there is no external pore directly connected with these open sacs. Otherwise they suggested to us the "brown funnels" or "atrio-cœlomic funnels" of *Amphioxus*, discovered by Lankester[1], which coexist in that animal with another kind of excretory organ, just as do the present structures with nephridia of the usual "perichætous" type. And it may further be remarked, that in the brown tubes the shape is much the same, though the wide opening is into the atrial cavity (*i. e.* the exterior). There is, however, as already stated, no visible and direct external orifice to these funnel-shaped tubes. But they enclose abundant nephridia, and of these we have ascertained external pores. So that after all the cavity of the cœlomic pouches does communicate with the exterior. It is conceivable that we have here a state of affairs comparable to that seen in certain Polychæta where, according to Goodrich[2], cœlomic funnels become secondarily connected with true nephridia. In *Pheretima* this connection is obviously vague and loose; but it may be, so to speak, a preparation for a closer

Text-fig. 38.



Transverse section through body-wall and underlying cœlomic pouches of *Pheretima posthuma*.

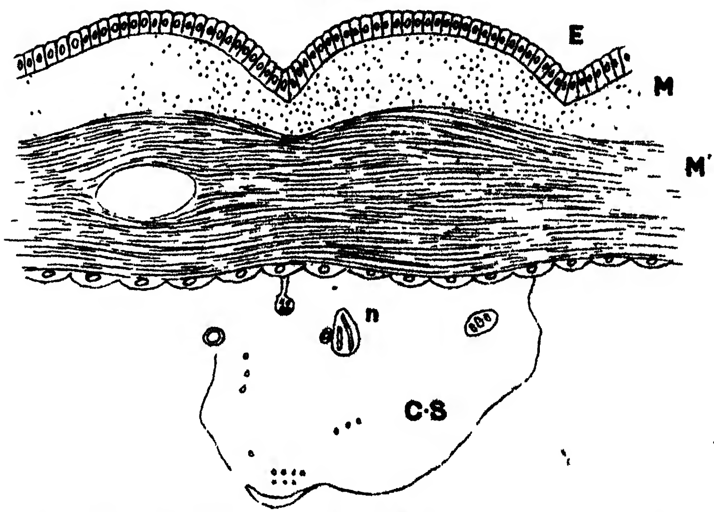
E, epidermis, C.S, cœlomic pouch, M, M', muscular layers of body-wall.

relationship. The microscopic structure of the walls and contents of these series of pouches has given no further clue to their morphological meaning, nor to the part which they play in the economy of the Annelid. The drawing exhibited (text-fig. 38) shows a longitudinal section through the couple of pouches of one side of the body, the "waist" or junction of the two being naturally in the middle. The walls are simple, composed of an

[1] "Contributions to the Knowledge of *Amphioxus lanceolatus*," Quart. Journ. Micr. Sci. xxix. p. 394.
[2] Goodrich: "On the Nephridia of the Polychæta," ibid. xli. p. 439.

extension of the peritoneum with lining of cells and a few slender muscular fibres. The wide opening at either end is conspicuous, and there is no difference of structure at this orifice. The wall simply leaves off. Transverse sections (text-fig. 39) taken at the widest part of the sac show that it forms here an absolutely closed sac, a chamber distinct from the general cœlomic cavity. Corpuscles were floating about, and, as already mentioned, nephridial tufts are frequent in the interior. Whatever may be

Text-fig. 39.



Longitudinal section through body-wall and underlying cœlomic pouch of *Pheretima posthuma*.

n, nephridia; other letters as in text-fig. 38.

the nature of this series of separate cœlomic cavities, there is in one genus of Oligochæta a set of cavities which may perhaps be comparable to them. In *Lybiodrilus*[1] the area surrounding the lateral setæ is in a similar way shut off from the general cœlomic cavity. There is not, however, in this case any conspicuous opening of the cavity so formed into the general cavity of the segments; the cavities in question are completely separated. Possibly in both cases we have to do merely with that tendency to the division of the cœlom into a number of completely or incompletely separated chambers which is so general in cœlomate animals. In any case, the facts described in the present communication appear to be novel, and at least furnish another example of the commencing subdivision of the cœlom in the Oligochæta which culminates in their nearest allies the Leeches.

[1] Beddard: "On the Structure of an Earthworm allied to *Nemertodrilus*, &c.," Quart. Journ. Micr. Sci. xxxii. p. 546.

4. On some Points in the Anatomy of the Alimentary and Nervous Systems of the Arachnidan Suborder Pedipalpi. By R. I. Pocock, F.Z.S.

[Received May 30, 1902.]

(Text-figures 40–45.)

1. *The Nervous System of the Opisthosoma in the* Thelyphonidæ.

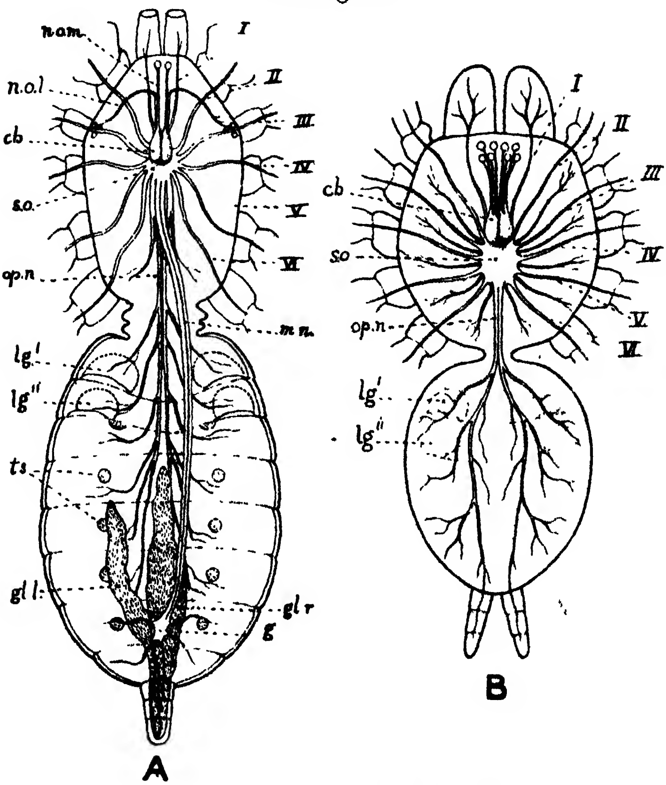
According to Blanchard[1] the opisthosoma of *Thelyphonus* is innervated as follows: From the postaxial side of the trunk supplying the sixth appendage of the prosoma springs a nerve which passes backwards parallel to the median cord into the pregenital somite, giving off a slip to the muscles of that limb. Towards the posterior end of the prosoma, the median nerve-cord, which is described as single, sends off on each side a nerve which traverses the pregenital somite and divides into two branches, one for the first or genital somite, the other for the second somite. The nerves supplying the third, fourth, fifth, and sixth somites spring from a common centre, forming a minute ganglionic swelling on the median cord in the anterior portion of the genital somite. In the seventh somite the median cord forms a relatively large ganglion, whence five nerves radiate to the five posterior somites of the opisthosoma.

Blanchard's observations were based upon a species from Martinique, now known as *Mastigoproctus antillensis*. I have had no opportunity of dissecting specimens of this species. I find, however, a very different state of things in a Burmese species, *Hypoctonus formosus*. In the first place, the median cord is not single, but double. In the second place, it gives off no nerves between its point of origin at the posterior extremity of the subœsophageal mass in the prosoma and its ganglionic enlargement in the seventh somite of the opisthosoma (text-fig. 40, A, *m.n.*, p. 170). All the nerves which originally emanated from it to supply the pregenital somite and the anterior six somites of the opisthosoma have passed forwards and become united to the ganglionic mass of the prosoma. They form on each side a compound strand rising between the median nerve-cord and the nerves of the sixth appendage (text-fig. 40, A, *op.n.*, p. 170). Running backwards for a short distance, parallel with the median cord, and giving off a slender nerve to the muscles of the sixth appendage, they soon dip beneath the cord and meet in the middle line in the narrow channel between the coxæ of the appendages of the fifth pair. Posteriorly from this point the two cords extend side by side along the sternal surface of the body, beneath the double median strand. The nerve to the genital somite rises in the posterior

[1] Org. du Règne Anim., Arachn. p. 152, pl. viii. fig. 4.

end of the prosoma; that for the second somite in the pregenital somite; that for the third in the genital somite; while those to

Text-fig. 40.



Nervous system of the Araneæ and of the Pedipalpi of the family *Thelyphonidæ*.

A. Nervous system of one of the *Thelyphonidæ* (*Mastigoproctus giganteus*).

I–VI. Nerves supplying the six appendages of the prosoma. *n.o.m.*, nerves to the median eyes; *n.o.l.*, nerves to the lateral eyes (according to Blanchard); *cb.*, cerebral or supraœsophageal ganglionic mass giving off the nerves to the eyes and to the appendages of the first pair; *s.o.*, subœsophageal nervous mass giving off the nerves to the five pairs of postoral appendages (II–VI), also the two principal cords (*op.n.*) innervating the anterior six metameres of the opisthosoma and the paired median nerve (*m.n.*) which terminates in a ganglion (*g*) supplying the muscles of the caudal region; *lg'*, *lg''*, first and second lung-sacs; *gl.r.* right, and *gl.l.* left "acid"-gland; *ts.*, tergosternal muscles.

[The median nerve-cord has been pulled aside to the right to show the subjacent nervous cords.]

B. Nervous system of a Mygalomorphous Spider of the family *Aviculariidæ* (modified from Blanchard's figure), to show the similarity between the nerves (*op.n.*) supplying the opisthosoma and those marked *op.n.* in the figure of *Thelyphonus*.

Lettering as in A.

supply the fourth, fifth, and sixth somites diverge close together from a point in the third somite, whence the two strands appear to be closely bound together with connective tissue.

Since the two strands here described are formed by the union of the six nerves supplying the six anterior somites of the opisthosoma, it is not always easy to decide by dissection the exact points of divergence, and it is possible that some individual or specific variation will be found in this respect. In the main, however, I believe the arrangement described above to be fairly accurate.

Laurie [1] correctly describes the median nerve-cord as double, but was unable to trace the course and distribution of the fine nerves he noticed running alongside of it from the posterior end of the prosomatic mass. Presumably, like Blanchard, he did not observe that these nerves dip beneath the main cord. In connection with the acid-glands he describes a convoluted mass of tubules twisting about on each side of the central or right gland, and succeeded in tracing two of these tubules, apparently opening into the left sac. These tubules he interpreted as the purely secretive part of the gland. May they not have been the fine branches of the inferior system of nerves torn from their anterior attachments? This view of the matter would account for Laurie's failure to trace the course and distribution of the lateral nerves passing backwards into the opisthosoma from the posterior end of the prosomatic ganglionic mass.

Tarnani [2] says nothing of the nervous system of the opisthosoma. The nervous system of the opisthosoma in *Phrynus* is of a far more primitive type than that which I have described above in the case of the Thelyphonidæ. The nerves supplying the genital and the two following somites have passed forwards into the prosoma to join the ganglionic mass of this region, arising from it on each side between the nerve for the sixth appendage and the median cord. The threads innervating the rest of the somites of the opisthosoma spring laterally from the median cord, although well in advance of the somites to which they belong. They thus exhibit a marked tendency towards the state of things that has been completed in the Thelyphonidæ—namely, the isolation of the median cord by the annexation of its lateral threads by the prosomatic mass.

In the Thelyphonidæ it seems clear that the innervation of the flexible posterior end of the opisthosoma is the sole function of the median cord. If these organs were suppressed, the nerve-cord would become useless and might cease to be developed. The whole of the sternal surface of the opisthosoma would then receive its nervous supply from the cords I have above described, which would certainly be taken for the primitive median cord, although they would in reality represent merely its original laterally and metamerically diverging threads.

[1] Journ. Linn. Soc., Zool. xxv. 1894.
[2] Rev. Sci. Nat. St. Pétersb. 1890, no. 5, p. 255.

A specialization of this nature may, I suggest, be the explanation of the peculiarities of the nervous system of the Araneæ.

In '*Mygale*,' according to Blanchard, the opisthosoma is innervated from a median strand which passes backwards from the prosomatic mass into the pregenital somite, the so-called pedicel, and divides in the opisthosoma into a right and left cord, widely separated from each other in the middle line (text-fig. 40, B, *op.n.*, p. 170). Each extends backwards to the spinning-appendages, breaking up terminally into threads to supply the anal region of the opisthosoma. Each, moreover, gives off externally three principal nerves. The first and second arise far forwards in the opisthosoma and innervate the genital and the following somite, with their pulmonary sacs (text-fig. 40, B, lg', lg'', p. 170); the third rises in the posterior third of the opisthosoma not far in advance of the point where the terminal cord breaks up into the threads above described.

This account I have verified in the case of *Ephebopus murinus*, a member of the same family as the '*Mygale*' dissected by Blanchard. The median cord that springs from the posterior end of the subœsophageal mass is, of course, double, although the two strands are very closely applied as they pass through the 'waist.'

The exact points in the opisthosoma where the three nerves part from the principal strands is, in the absence of ganglionic centres, difficult to ascertain with accuracy, and probably varies in different types. Nevertheless the arrangement that Blanchard has depicted is in the main correct. A very similar state of things obtains in the Arachnomorphæ, where the opisthosoma is innervated on each side by four nerves which diverge from the common cord that proceeds from the prosoma into the genital somite of the opisthosoma.

If now, as is generally assumed to be the case, the two admedian nerve-strands represent the primitive median cord, their wide separation is not the only anomaly they present; for we shall be confronted with the fact that the Araneæ are the only Arachnida known in which all the somites of the opisthosoma are innervated by cords which spring from the main trunk within the opisthosoma itself. In all other orders, one (as in *Limulus*) or more of the somites in question receive their supply from the prosomatic mass with which their ganglionic centres have coalesced.

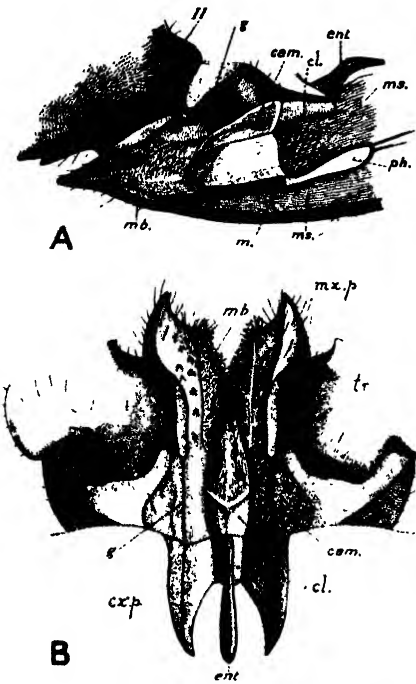
I venture to suggest, then, that in the Spiders the nerves of the opisthosoma represent the inferior system that has been described in the Thelyphonidæ, and not the primitive median strand with lateral branches as has been heretofore supposed.

2. *The Alimentary System of the Prosoma and Structure of the Mouth-parts in the* Pedipalpi *and other* Arachnida.

The first point to be noticed in the alimentary system of the Thelyphonidæ is the modification of the structure of the coxal or basal segments of the chelæ (appendages of the second pair). These segments, which were ancestrally freely articulated to the

fore part of the prosoma behind the mouth, have converged towards one another, so that laterally they embrace the sides of the camarostome or labrum (text-fig. 41, *cam.*). Dorsally, the proximal portion of the inner edge on each side forms a hinge-like joint with the adjacent edge of the dorsal wall of the

Text-fig. 41.



Mouth-parts of the *Thelyphonidæ* (*Mastigoproctus giganteus*).

A. Inner aspect of the base of the right chela, that of the left side being cut away to show the camarostome in place, &c. · *ent.*, median entosclerite rising from the membrane above the base of the camarostome and affording support to the dorsal dilator muscle of the pharynx; *cl.*, proximal plate (clypeus) of camarostome which is articulated to the adjacent area of the coxa of the chela; *cam.*, hairy membranous portion of camarostome (*labrum*). *mb.*, hairy membranous area of inner surface of the coxa of the chela; *mx.p.*, maxillary process of the latter; *m.*, mouth lying beneath the base of the camarostome at the end of the long suboral trough formed by the fusion of the coxæ; *ph.*, anterior or pharyngeal portion of the stomodæum or foregut forming the pre-cerebral sucker of the alimentary canal; *ms.*, muscular tissue filling the cavity of the coxæ of the chelæ and of the camarostome. *tr.*, portion of the trochanter or second segment of the chela; *g.* groove on the inner (preaxial) side of the coxa formed by an infolding of the chitin.

B. Dorsal area of the camarostome and of the basal segments of the coxæ of the chelæ when the anterior end of the carapace and the chelicerae are removed.

Lettering as in A, with *cx.p.*, process of coxa which projects into the prosoma and supports the lateral dilator muscle of the pharynx.

camarostome; and the inner edges of their lower surface form a similar hinge-like union with each other in the middle line, this hinge appearing externally from beneath as a longitudinal groove passing between the two segments. These two hinges permit only of a restricted range of movement of the coxæ in a vertical plane, whereby the camarostome is compressed between them.

Originally, no doubt, the two apposed preaxial surfaces of the coxæ, where they met beneath the mouth and camarostome, persisted as a double partition separating the cavity of the coxa of the right side from the cavity of the coxa of the left side. But in existing forms this partition has disappeared, so that the cavities communicate freely with each other, the muscles of the two being contiguous in the middle line (text-fig. 41, A, *ms.*, p. 173).

The camarostome (rostrum, labrum) is large, broad in its basal half, narrowed and depressed at the apex, and wedged in between the coxæ of the chelæ, as described above. Its dorsal wall consists posteriorly of a chitinous plate, so-called *clypeus* (text-fig. 41, A, B, *cl.*, p. 173), which is laterally hinged on each side, as already stated, to the adjacent edge of the coxa, and is continuous posteriorly with the membrane that forms the anterior boundary of the prosoma. This membrane is folded forwards over the proximal portion of this plate and closely applied to it; and from the middle of its area arises a stout, hooked entosclerite, which projects backwards into the cavity of the prosoma (text-fig. 41, A, B, *ent.*, p. 173). Owing to the overfolding of this membrane and the closeness of its contact with the horny plate (*clypeus*), the latter appears upon dissection to jut backwards into the body-cavity, and the hook-shaped entosclerite appears to be an upgrowth from the middle of its dorsal surface. Maceration in caustic potash, however, reveals the true relations of the parts, and shows, further, that the entosclerite itself is a hollow invagination of the integument and unconnected with the horny plate.

Beyond its point of union with the coxæ, the camarostome is a free, membranous, or weakly chitinized hairy lobe. Distally, it is compressed and descends between the coxæ, overhanging the mouth and forming a flexible upper lip, hairy in the middle, and encircled laterally and below with a fringe of close-set, perhaps sensory hairs, which no doubt act also as a mechanical sieve, as Bernard says, to strain the solid from the liquid elements of the food. The cavity of the camarostome, which is irregularly elliptical in transverse section, is filled for the most part with muscles which pass from its roof to its floor, the latter being the dorsal wall of the entrance to the alimentary canal. When the dorsal integument or roof of the camarostome is cut away and the muscular tissue removed to display its floor, the latter is seen to be formed like the bowl of a deep and pointed spoon, the short handle of which is represented by the dorsal wall of the pharyngeal portion of the foregut with which the floor of the camarostome is posteriorly continuous.

The entrance to the alimentary canal between the camarostome above and the coxæ below is a wide, transversely crescentic slit with the concavity looking upwards. Its floor and outer sides are formed by a thickly chitinized, deeply hollowed plate, continuous along its upper and exterior edge on each side with the adjacent area of the inner surface of the coxa, of which it is a part; and posteriorly with the posterior extremity of the side of the camarostome, to which it is attached by membrane. It is finely grooved transversely, and beset with a thick coating of short delicate hairs. Posteriorly it is constricted, and in the middle line passes into the relatively narrow pharyngeal portion of the alimentary canal (text-figs. 42, C, *lam.*, p. 177, and 44, *lam.*, p. 183).

The roof and inner walls of the crescentic slit are formed by the sides and lower surface of the camarostome, which lies in the hollow of the plate described above, the two being united by membrane only along their posterior edges. Fine hairs clothe these surfaces of the camarostome, and a thick fringe of hairs projects beyond the apex from near the distal extremity of this organ. The under surface of the camarostome is posteriorly continuous in the middle line with the dorsal wall of the pharynx, as already stated (text-fig. 41, A, *cam.*, *ph.*, p. 173).

The crescentic slit above described is not closed above, but opens on each side between the outer surfaces of the camarostome and the adjacent inner surfaces of the coxæ of the chelæ, which are continuous with the horny plate forming the outer sides and floor of the slit. Fluid taken into the slit would be prevented from escaping upwards through its open extremities by the hairs clothing the inner side of the coxæ (text-figs. 41 & 42, *mb.*, pp. 173, 177) and the outer portion of the upper surface of the camarostome.

It will thus be clear that the so-called mouth of the Thelyphonidæ, *i. e.*, the aperture that lies between the tip of the camarostome above and that of the horny plate below, is a secondarily acquired aperture produced by the forward extension and union of the coxæ of the chelæ and the elongation and depression of the camarostome. The true mouth, *i. e.*, the entrance to the stomodæum or foregut, representing the mouth of the Scorpions and *Phrynus*, is the relatively narrow aperture by which the pharynx debouches into the above described slit (text-fig. 41, A, *m.*, *ph.*, p. 173).

The key to the mode of formation of this arrangement is to be found in the mouth-parts of the Amblypygi (*Phrynus*), which so far, at all events, as the freedom of the coxæ of the chelæ is concerned, are admittedly less specialized than those of *Thelyphonus*. In *Phrynus* the camarostome is relatively a very small flexible lobe overhanging the mouth, and furnished dorsally with a small heart-shaped sclerite representing the chitinous plate of *Thelyphonus* (text-fig. 42, A, B, *cam.*, *m.*, p. 177). The coxæ of the chelæ have fused below the mouth and separate it entirely from the forwardly directed prosternal plate of the prosoma, which is the sternum of the second postoral somite (text-fig. 42, A, B, *st.*, p. 177). When forcibly

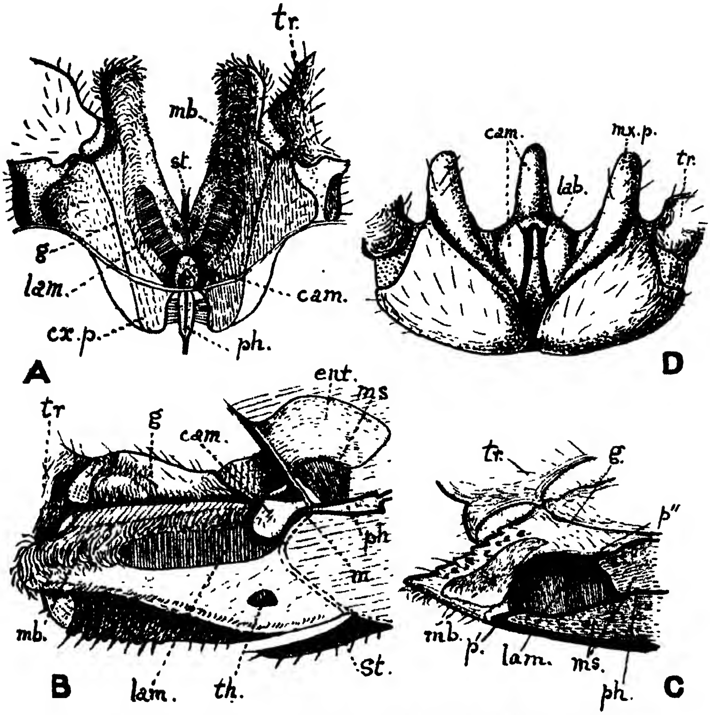
approximated in the middle line, in simulation of the position those of *Thelyphonus* have permanently assumed, the coxæ of *Phrynus* form a long channel, or gutter, open above and extending from their distal extremities backwards to the mouth. The sides of this channel are beset with longish hairs over the greater part of their extent (text-fig. 42, A, B, *mb.*, p. 177); but proximally on each side there is a sharply defined, elongate, pubescent area, which fuses with its fellow of the opposite side immediately below the mouth, and stretches a considerable distance forwards in advance of it. Stripped of its pubescence, this area is seen to consist of a horny thickening of the integument (text-fig. 42, A, B, *lam.*, p. 177). If the coxæ were to fuse in the middle line, the union of these chitinous areas would form a horny plate similar to that of *Thelyphonus*, and the enlargement of the camarostome and the fusion of its basal sclerite with the coxæ would reproduce the state of things now found in the last-named genus.

Bernard's account and figures of the mouth of *Thelyphonus* I cannot reconcile with the facts just described. In his paper on the morphology of the Galeodidæ[1] (p. 357) he says: "*Thelyphonus* also [*i. e.* as well as *Galeodes*] has a beak, but it is enclosed between the basal joints of the pedipalps, which are fused below it but are open above it. The cheliceræ crush the prey into the channel thus formed by the coxæ of the pedipalps, and the juices are drawn in by the powerful pumping apparatus. They are strained by transverse rows of fine hairs, which line the aperture." And in the preceding page he says: "We find . . . . . the pumping apparatus contained in a beak in such widely different groups as *Galeodes*, *Thelyphonus*, and *Gamasus*."

From this it might be inferred that *Thelyphonus* has a beak resembling that of *Galeodes*, but with its inferior surface fused to the subjacent area of the trough-like hollow formed by the fused inner (preaxial) surfaces of the chelæ (pedipalps). And the three figures representing transverse sections of the buccal region bear out this interpretation. The first section, taken near the extremity of the camarostome, and the second probably near its middle, clearly show the crescentic slit-like hair-lined entrance to the alimentary canal which Bernard regards as the oral aperture. But the two upwardly directed extremities of this canal are represented as closed above. Moreover, these two figures show the coxal cavities of the right and left sides separated from each other by a median vertical partition extending to the floor of the space in which the 'rostrum' rests. I have not found this partition in any adult *Thelyphonus*. No doubt it was present in the young and in the parent form of the race. Its persistence in the adult as the thick horny rod depicted in Bernard's drawings would considerably interfere with the movements the coxæ perform to compress the camarostome. The third section, passing apparently through the camarostome a short distance in front of the

[1] "Comparative Morphology of the Galeodidæ," Trans. Linn. Soc. ser. 2, Zool. vi. pp. 305-417.

Text-fig. 42.



Mouth-parts of the Pedipalpi of the families *Thelyphonidæ*, *Phrynidæ*, and of the Pseudoscorpiones (*Chernetes*).

A. Portion of the inner surface of the right coxa of the chela of one of the *Thelyphonidæ* (*Hypoctonus formosus*) with lettering as in text-fig. 41, and *lam.*, one half of the finely grooved and hairy spoon- or bowl-shaped lamina which embraces the camarostome and forms the floor of the preoral gutter with which the ventral wall of the pharynx (*ph.*) is continuous; *p'*, point marking the anterior extremity of the hinge resulting from the fusion of the inner surfaces of the two coxæ; *p''*, point marking the anterior extremity of the hinge between the proximal plate (*clypeus*) of the camarostome and the coxa of the chela.

B. Lateral view of the mouth-parts of *Titanodamon johnstoni*, one of the amblypygous Pedipalpi, showing the inner (preaxial) surface of the coxa of the chela of the right side, that of the left side being cut away with the cheliceræ: *ent.*, vertical median entosclerite affording support to the dorsal dilator muscle (*ms.*) of the pharynx (*ph.*); *cam.*, camarostome with its horny basal sclerite overhanging the mouth (*m.*); *lam.*, horny plate on the coxa of the chela, representing one half of the grooved spoon-shaped suboral sclerite of the *Thelyphonidæ*; *mb.*, hairy membranous tract; *tr.*, portion of second segment or trochanter of chela; *g*, coxal groove; *th.*, thickening of the integument of the coxa to afford support to the anterior ventral apophysis of the entosternite; *st.*, sternal plate of second postoral somite.

C. Dorsal view of the coxal segments of the chelæ of *Titanodamon johnstoni*, with the camarostome and pharynx. Lettering as in B.

D. Ventral view of the mouth-parts of one of the Pseudoscorpiones (*Garypus*), the coxæ of the chelæ forcibly separated to show the narrow blade-like hypostomial process or labium (*lab.*), which perhaps represents the sternal plate of the first postoral somite, projecting between the two inferior lobes of the camarostome (*cam.*); *mx.p.*, membranous maxillary process of the coxa.

true oral aperture, shows the inferior wall of the still wide, but less strongly crescentic slit to be formed by a thickish transverse horny plate which is described as the "persistent sternum of the 1st and 2nd segments" or the "supporting-rod of the labium." Reference for comparison is given to a figure showing what purports to be the same plate projecting forwards between the coxæ when these segments are viewed from below, although the figure showing the plate in transverse section represents it as situated high above the lower surface of the coxæ. This plate is no doubt the thickened portion of the floor of the crescentic slit, which is situated just in front of the true oral aperture; but I cannot establish any connection between it and the prosternum (sternum of the second postoral somite), or any part of the sternal exoskeleton.

Again, speaking of the "beak" of Arachnida, Bernard says (*op. cit.* p. 391):—"The possession of this organ in such diverse Arachnida as *Galeodes*, *Chernes*, and *Thelyphonus*, and the easy deduction of the mouth-parts of Spiders, *Scorpio* and *Phrynus*, from such an organ, renders it almost certain that a beak was present in the original Arachnid."

If the "beaks" of *Galeodes*, *Chernes*, and *Thelyphonus* were similarly constructed organs, this argument would have weight; but, as a matter of fact, each of the orders represented by the three Arachnids cited possesses a "beak" which is *sui generis* and distinct from that of the other two, as well as from that of all the other orders of the class[1].

Far more probable is it, in my opinion, that the "beaks" of *Thelyphonus*, *Galeodes*, and *Chernes* are derivatives of mouth-parts of a much simpler type, consisting primarily of a camarostome or prostomial labrum overhanging the oral aperture. So, too, from this type can be deduced the very highly specialized "beak" of a fourth kind which is met with in many Spiders, *e. g.*, *Filistata*, *Sicarius*, &c.

In fact, the types of mouth-parts characteristic of Scorpiones, *Thelyphonus*, *Phrynus*, *Galeodes*, Pseudoscorpiones, Araneæ, &c., are all traceable to one and the same simple plan of structure, the modifications that are presented resulting from the formation, one might almost say the necessity for the formation, of a suboral trough to take up nutritive fluids. The one feature these mouth-parts have in common is the labrum or camarostome. In the Scorpiones the suboral trough is formed by the sterno-coxal (maxillary) processes of the third and fourth appendages (1st and 2nd walking-legs) (text-fig. 43, A, B, III, IV, p. 180). In *Phrynus* it results from the basal union beneath the mouth and the potential approximation throughout their length of the preaxial surface of the coxæ of the appendages of the second pair (chelæ or palpi).

[1] The diagrams representing transverse sections of the mouth-parts in *Scorpio*, *Obisium*, and *Galeodes*, figured on pl. xxvii. figs. 9 *a*–9 *c* of Bernard's paper, show very clearly the resemblances and differences and the true relations of the organs.

From this arrangement may be derived that of *Thelyphonus*, as already described (p. 175).

In the Spiders the trough is formed by the median prosternal plate (the labium or sternum of the first postoral somite) which projects from beneath and beyond the mouth (text-fig. 43, D, *lab.*, p. 180). The space on each side between this plate and the camarostome is blocked by the coxa of the appendage of the second pair. Within the order Araneæ the simplest type of mouth-parts is found in the primitive Mesothelæ and Mygalomorphæ, where the camarostome is high and short, and the coxæ in question but little modified. In the Arachnomorphæ, on the contrary, the camarostome is longer, depressed, and overlaps the labium, the two being flanked on each side by a preaxial process from the coxa—the so-called maxilla (text-fig. 43, C, D, *cam.*, *mx.p.*, p. 180). In more primitive forms the appendages of the first and second pairs (mandibles and palpi) are freely movable, and the labium is separated from the rest of the sternum. But in certain other forms the labium and basal segments of the palpi are fused to the sternum, the maxillary processes meet in front of the labium, and the mandibles are mesially hinged together and susceptible of but little movement; the five sclerites in question, together with the camarostome which they completely enclose, constituting a highly specialized "proboscis," equal in complexity to that of many Acari.

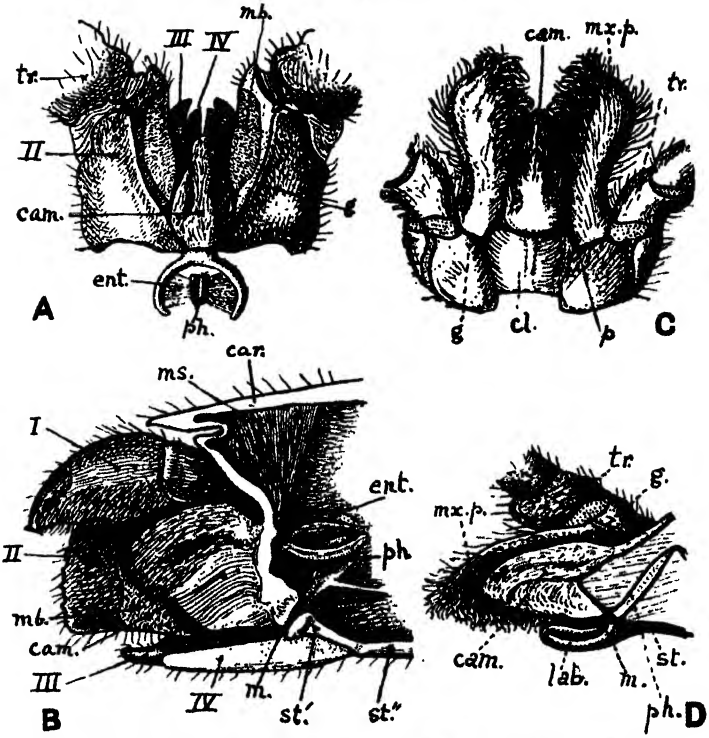
Viewed from above, the mouth-parts of the Pseudoscorpiones (*Garypus*) much resemble those of *Thelyphonus* and the Spiders. The camarostome is long, porrect and, as in *Thelyphonus*, fused dorsally on each side in its basal half to the adjacent preaxial surface of the coxa of the 2nd appendage (chela), which projects forwards on each side of it. Distally, it ends in a subcylindrical fleshy lobe which reaches to the end of the membranous sterno-coxal (maxillary process) of the coxa (text-fig. 42, D, *cam.*, *mx.p.*, p. 177). Inferiorly, however, instead of being uniformly convex, it is deeply grooved longitudinally, the groove giving rise to a pair of lips, a right and a left. Projecting forwards into the groove between these two lips is a compressed and pointed prosternal or labial prolongation, which arises at its basal end from the inferior part of the area between the juxtaposed proximal ends of the preaxial surfaces of the coxæ (text-fig. 42, D, *lab.*, p. 177). These coxæ meet, without fusion, in the middle line beneath the prosternal process, and form, as in *Thelyphonus*, a trough to prevent the escape of fluid; the labium (prosternum), which, like the lips of the camarostome, is thickly hairy, constituting a kind of tongue-like organ [1], above their line of meeting.

In the Podogona or Ricinulei (*Cryptostemma*) and most (? all) Acari the suboral trough results from the union of the coxæ of the palpi beneath the camarostome.

In the Solifugæ (*Galeodes*) the "beak" is quite peculiar. It consists of a horizontally porrect tubular proboscis, bearing the

[1] See Croneberg, Arch. f. Nat. 1880.

Text-fig. 43.



Mouth-parts of the Scorpiones and of the Araneæ of the family *Lycosidæ*.

A. Dorsal view of the mouth-parts of a Scorpion (*Palamnæus*), with the cheliceræ removed: *ent.*, crescentic entosclerite supporting the lateral dilator muscles of the pharynx (*ph.*); *cam.*, camarostome; II, coxa of second appendage or chela, with *mb.*, hairy membranous tract, and *g*, entapophysial groove; *tr.*, trochanter or second segment of chela; III and IV, sterno-coxal or maxillary processes of third and fourth appendages (first and second walking-legs) forming the suboral trough.

B. Lateral view of the mouth-parts of a Scorpion (*Palamnæus*), the chela, chelicera, and anterior portion of the prosoma of the left side removed: *car.*, cut edge of middle line of carapace; *ms.*, vertical muscle passing from carapace to the crescentic entosclerite (*ent.*); I, appendage of first pair, or chelicera; *m.*, mouth leading into pharynx or pre-cerebral sucker (*ph.*); *st.'*, anterior portion of sternal area of prosoma, which is normally concealed by the coxa and sterno-coxal process of the appendage of the fourth pair (IV), forming the suboral trough; *st.''*, posterior or exposed part of the sternal area forming the pentagonal metasternite.

C. Dorsal view of the mouth-parts of a Spider (*Lycosa ingens*), with cheliceræ removed, showing the camarostome (*cam.*) flanked on each side by the large maxillary process (*mx.p.*) of the coxa of the second appendage or palpus: *cl.*, basal sclerite (*clypeus*) of camarostome, which is united with the adjacent area of the coxa as far as the point *p*; *g*, entapophysial groove of coxa lying transversely, not longitudinally as in the Scorpiones, Pedipalpi, and Pseudoscorpiones.

D. Lateral view of the same, with the same lettering as in C, with *m.*, mouth leading into pharynx or pre-cerebral sucker (*ph.*): *lab.*, labium or sternal plate of first postoral somite forming the suboral trough; *st.*, anterior portion of median sternal sclerite.

aperture of the alimentary canal at its apex. Its dorsal wall is formed by the horny compressed camarostome. Its ventral wall is an outgrowth of the suboral area of the prosoma, supported posteriorly by a prosternal sclerite and by the juxtaposed coxæ of the palpi, fused laterally to the camarostome throughout its length; it thus constitutes a lower lip which effectually prevents the loss of liquid food, without any share in this office being taken by any part of the coxæ of the adjacent appendages. The special point in which this "beak" resembles that of the Acari is the fact that it forms the sucking-apparatus of the alimentary canal. Otherwise it is unique in the class Arachnida, its parallel being found only in the, in some respects, degenerated Palpigradi.

That a "beak" of this kind, which is evidently developed in correlation with the long, porrect, and non-retractile cheliceræ, was the starting point of the diverse modifications met with in the other orders of Arachnids, seems in the highest degree improbable. Such an hypothesis demands the suppression of the lower lip of the "beak," and its independent replacement functionally by the particular types of suboral trough already described.

On the other hand, there is no difficulty in regarding all these various kinds of "beaks" as specialized organs resulting from the presence of a camarostome or labrum, and the need for a lower lip or suboral gutter to prevent the loss of nutritive fluids and to guide them into the alimentary canal.

The muscles of the camarostome in *Thelyphonus*, which Bernard regards as the beginning of "the sucking-apparatus," seem to have the same function as those of the Scorpion, being, as in that animal, distinct from the suctorial pharynx, which constitutes "the sucking-apparatus" *par excellence*.

In connection, then, with the anterior portion of the alimentary canal, suckers may be developed in three distinct places—that is to say, in the camarostome itself, as in the Solifugæ, Palpigradi, and Acari; in the pre-cerebral portion of the foregut, as in the Scorpiones (text-fig. 43, A, B, *ph.*, p. 180), Opiliones, and Pseudoscorpiones; or in its post-cerebral portion, as in the Araneæ, Palpigradi [1], and Amblypygous Pedipalpi (*Phrynus*).

In the Araneæ and Amblypygi (text-fig. 45, *ph.*, *st.*, p. 186) the pre-cerebral and post-cerebral suckers coexist, and are especially powerful in the former order. In the Palpigradi the post-cerebral sucker is aided in its work by the organ developed in the camarostome. In the Scorpiones and Opiliones the pre-cerebral sucker alone is found. In the Uropygous Pedipalpi it is also well developed; the post-cerebral, on the contrary, is very small as compared with that of the Amblypygi, but the muscles of the camarostome probably aid in the office of suction. The same is true of the Pseudoscorpiones, with the exception that the post-cerebral sucker is absent. In the Solifugæ and Acari the function of suction is apparently performed solely by the muscles of the camarostome.

[1] Rucker, Amer. Nat. xxxv. 1901.

The pharyngeal portion of the foregut in *Thelyphonus* which opens at its anterior end into the slit above described is a wide membranous tube, strengthened with four chitinous strands, a right and left upper and a right and left lower. The latter are directly continuous with the chitinous plate forming the floor of the suboral trough; the former with the posterior extremity of the lower surface of the camarostome forming the roof of the trough. From its dorsal walls muscles pass to the under surface of the median entosclerite which arises from the membrane above the base of the camarostome, and from its sides muscles extend to an injutting process from the coxa of the chela[1] (text-fig. 41, A, B, *ent.*, *cx.p.*, p. 173).

It thus constitutes a powerful, dorso-ventrally compressed, pharyngeal or pre-cerebral sucking apparatus, homologous to that of the Scorpions and Spiders (text-fig. 43, D, *ph.*, p. 180). In the Scorpions, however, the organ is compressed from side to side, and its lateral muscles pass to the crescentic preoral entosclerite, which represents the median entosclerite above the camarostome of *Thelyphonus*[2] (text-fig. 43, A, B, *ent.*, *ph.*, p. 180).

From this point the foregut narrows and runs backwards through the brain as a relatively soft, flexible, and weakly chitinous tube. Between the brain and the anterior bridge of the entosternite it forms a lanceolate expansion, comparable to the so-called "sucking-stomach" of the Spiders, though not, apparently, supplied with the powerful dilator and contractor muscles characteristic of this organ in the last-named order.

Behind this expansion the gut passes between the descending branches of the aorta and expands into the saccular stomach of the midgut. This is provided with five pairs of principal diverticula, which are often of irregular shape and sometimes asymmetrically branched, and extend towards the coxæ of the postoral appendages, sometimes dipping into the cavities of those of the legs (text-fig. 44, 1–5, p. 183). The diverticula of the anterior pair arise behind the descending portion of the aorta, and passing forwards on each side of it, unite in the middle line, thus circumscribing a space through which, in addition to the aorta, the obliquely ascending pair of apophyses from the entosternite runs

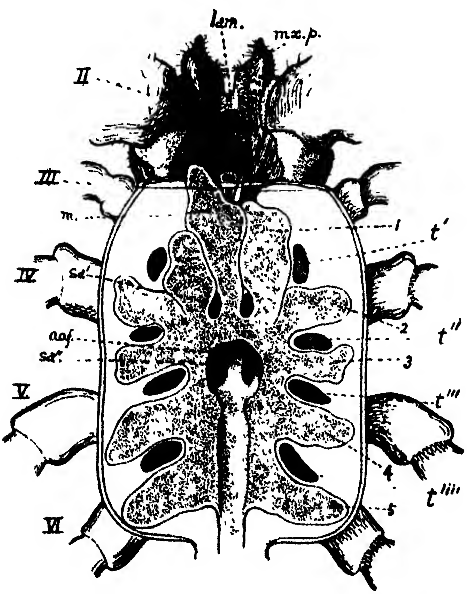
[1] From Laurie's description it is not clear which of the two apertures, *i. e.* that at the distal or at the proximal end of the camarostome, he signifies by the word "mouth." Probably scarcity of material prevented an accurate dissection of this region; otherwise it is difficult to account for the misleading statement that the foregut (stomodæum) of *Thelyphonus* has "no appearance of a dilatation into a sucking stomach such as is found in the Scorpion"; nor for the erroneous assertion that "the muscles of the anterior part of this stomodæum" pass to three chitinous processes running back from the camarostome. Two of these three entosclerites are the injutting angular processes of the coxæ of the chelæ, and the third arises from the membrane above the camarostome.

[2] It is singular that Blanchard (Org. du Règne Anim., Arachnides) overlooked this enlarged pre-cerebral pharyngeal sucking portion of the alimentary canal in *Thelyphonus*. The same oversight characterizes his observation upon this region in '*Mygale*,' and, as Huxley pointed out, in *Scorpio*. In the case of *Phrynus*, however, he both figured and described it, homologizing it with the œsophageal portion of the canal in *Thelyphonus*.

to their points of attachment to the middle line of the posterior half of the inner surface of the carapace (text-fig. 44, *sa''*).

In front of this space arises a median unpaired diverticulum which extends forwards between the diverticula of the anterior pair; and protruding on each side of it may be seen a second pair of muscles which run to the carapace from the branch of the entosternal apophysis just mentioned (text-fig. 44, *m.*, *sa'*).

Text-fig. 44.



Alimentary system of the prosoma of the *Thelyphonidæ*.

Prosoma of one of the *Thelyphonidæ* (*Hypoctonus formosus*), with carapace, camarostome, and chelicerae removed. II–VI. Basal segments of the five pairs of postoral appendages; *mx.p.*, maxillary process of coxa of chela; *lam.*, spoon-shaped plate which underlies the camarostome; 1–5, lateral cæcal diverticula of midgut; *m.*, anterior median diverticulum of midgut; *t'–t''''*, the four lateral apophyses of the entosternite representing the tergo-sternal muscles; *sa'*, anterior branch and *sa''*, posterior branch of the supernumerary apophysis: *ao.f.*, foramen through which the aorta descends to the ventral region of the body and the muscular apophyses (*sa''*) ascend to the median line of the carapace.

The arrangement of the remaining diverticula with regard to the four pairs of lateral tendinous processes of the entosternite is typically as follows:—The fifth or last pair passes behind the fourth or last process, the fourth, third, and second respectively between the fourth and third, third and second, second and first apophyses of this plate; the first, as already described, running straight forwards on the inner or admedian side of the first

apophysis, which rises from the distal extremity of the anterior bar of the entosternite (text-fig. 44, t'–t'''', p. 183). The form and position of these diverticula, however, seem to vary considerably in accordance with the degree of their distention with food-particles. When filled from base to extremity they are of fairly uniform width throughout. When partially empty their distal portions take the form of slender subcylindrical tubes differing considerably, both in appearance and shape, from the charged basal portions.

To this difference is to be ascribed Blanchard's[1] erroneous description of the stomach as consisting of four pairs of lateral cæca, enveloped above and below by a large tubular or salivary gland. In the specimens he dissected, belonging to the species now known as *Mastigoproctus antillensis*, the four posterior pairs of cæca appear to have been partially empty, while the anterior cæca and the central portion of the midgut were distended. I have found a similar state of things in the examples of *Mastigoproctus giganteus* and of *Uroproctus assamensis* that I have examined, whereas in all the examples of *Hypoctonus formosus*, all collected at the same time, the diverticula were evenly filled throughout. Hence the possibility that the width of the terminal portions of the diverticula may vary with the species, and may not be attributable to the cause I have suggested, must be borne in mind. Blanchard neither figures nor describes the anterior median diverticulum, present in all the specimens of Thelyphonidæ I have examined. Possibly it was not distended in his examples. Apart from this discrepancy, and from a too sharply defined line of demarcation between the filled and unfilled portions of the cæcal diverticula, evidently introduced to emphasize the distinctness of the so-called "tubular" or "salivary" gland, his figures admirably represent the "stomach" in this group, even to the spaces through which the two pairs of muscles pass to the middle line of the carapace. They also show the two inferior median diverticula which dip down through the median foramina of the entosternite and extend along its underside. Being filled with food, these were described as part of the tubular or salivary gland. Laurie mentions them as well. This author's description of the thoracic portion of the midgut as expanded into wide lateral diverticula, which extend over the brain in front and the coxal glands at the sides, each diverticulum being divided into five lobes, is correct so far as it goes, but too insufficiently detailed to criticise. The figure

[1] Blanchard (Org. du Règne Anim., Arachnides) described the "stomach" of *Thelyphonus* as consisting of a sac giving off four pairs of cæcal diverticula and enveloped above and below by voluminous glands of two kinds, described in the text as "utricular" and "tubular" glands. The former (=coxal gland), embracing the stomach laterally, are compared to the "salivary" glands, so-called by Newport and Müller, of the Scorpions.

How Blanchard and others, for reasons that need no explanation, ascribed an alimentary function to the coxal gland is now ancient history; but his mistake in homólogizing the coxal glands of *Thelyphonus* with the prosomatic midgut diverticula of *Buthus* is less intelligible. A further error into which he fell was the interpretation of part of the midgut diverticula in *Thelyphonus* as a "tubular" digestive gland.

that is given of the organ, however, suggests an arrangement of diverticula quite different from that obtaining in the specimens dissected by Blanchard, Tarnani, and myself. It represents a wide diverticulum as arising, on each side, *in front* of the descending trunk of the aorta, and extending backwards on each side of the horizontally lying portion of this vessel to the posterior end of the prosomatic cavity, giving off the five cæcal diverticula along its course. There is nothing to indicate the formation of the annular space through which the aorta and the two muscular tendons of the entosternite pass.

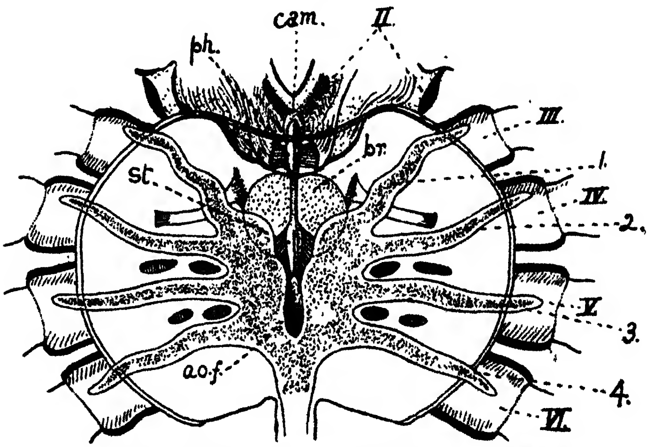
Tarnani says the foregut of *Thelyphonus* is like that of the Spiders. This seems to be an overstatement of the case. In the Spiders, the dorsal muscle of the pre-cerebral pharyngeal sucker extends to the median line of the anterior portion of the carapace, not to a chitinous entosclerite as in *Thelyphonus*. Moreover, the wall of the œsophageal portion of the foregut is much more thickly chitinized and more rigid than in *Thelyphonus*, and is supplied with a well-developed post-cerebral sucking-apparatus lying on the upperside of the entosternite and worked by powerful lateral muscles which attach it to this plate, and by a dorsal muscle which passes from its chitinous dorsal wall through the aortic space of the "stomach" to the median entapophysis of the carapace.

In many structural characters the Amblypygi are intermediate between the Urotricha (Thelyphonidæ) and the Spiders. This is strikingly the case with regard to the foregut. The pharyngeal portion is narrower and less strongly chitinized than in *Thelyphonus*, and the muscles of the pre-cerebral sucker extend dorsally to a median entosclerite rising from the membrane above the base of the camarostome, and laterally to the coxæ of the chelæ. The latter, however, are not immovably united like those of *Thelyphonus*, but move freely in a horizontal plane, and compress the sucker between their inprojecting ends. The œsophageal portion of the foregut is a sinuous tube with rigid chitinous walls, like that of the Araneæ; and behind the brain it forms a highly developed sucking-apparatus, with dorsal muscle extending to the undersurface of the carapace and lateral muscles passing to the entosternite. This organ differs from that of the Spiders only in position. Instead of resting upon the entosternite and being attached to its upperside by transverse muscles, it lies in front of it in the "pharyngeal notch," the lateral muscles extending to the anterior border of this plate. Thus in position it resembles the less highly specialized organ of *Thelyphonus*.

The midgut expansion, with its diverticula, more resembles that of some Spiders than of the Thelyphonidæ. As in these groups, the primary saccular diverticulum extends forwards on each side of the descending aorta, forming a channel through which this vessel continues its downward course, and the muscle from the post-cerebral sucker and the two obliquely directed apophyses from the entosternite ascend to the median depression on the

carapace. In front of this channel the two diverticula generally meet and overlap as in some Spiders (e. g. *Argyroneta*, according to Plateau), but without fusing or communicating. The diverticula of the anterior pair, which are so conspicuous in the Thelyphonidæ, remain undeveloped. Those that extend into the coxæ of the 3rd, 4th, 5th, and 6th appendages are relatively slender unbranching tubes, longer and more regular in shape than those of *Thelyphonus*. Their relation to the entapophyses of the entosternite differs also from that which obtains in *Thelyphonus* and the Spiders, where the five diverticula typically pass with regularity between the four apophyses which rise to the sides of the under surface of the carapace (text-fig. 45, 1–4).

Text-fig. 45.



Alimentary system of the prosoma of one of the *Phrynidæ*.

Dorsal view of the alimentary system of the prosoma of a Phrynid (*Titanodamon johnstoni*, partially diagrammatic). II–VI. Basal segments of the five pairs of postoral appendages; *cam.*, camarostome; *ph.*, pharynx or pre-cerebral sucker of the foregut; *br.*, subœsophageal portion of central nervous system traversed by the chitinous œsophagus which expands into the post-cerebral sucker of the foregut (*st.*); 1–4, cæcal diverticula of the midgut passing between the muscular apophyses of the entosternite, as described in the text; *ao.f.*, foramen or channel through which the dorsal aorta descends to the ventral region of the body and a pair of muscular apophyses (not shown in fig.) ascend to the middle line of the carapace.

In the Amblypygi these four apophyses are represented by six, the first and second apparently corresponding to the first in *Thelyphonus* and the Spiders, the third to the second, the fourth and fifth to the third, and the sixth to the fourth. The fourth and last diverticulum in *Phrynus*, corresponding to the fifth and last in *Thelyphonus* and the Spiders, passes, as in those groups, behind the last apophysis; and the first diverticulum in *Phrynus*, corresponding to the second in *Thelyphonus* and the Spiders, passes

on the outer and posterior side of the first apophysis between it and the second, which results apparently from its fission and is unrepresented in *Thelyphonus* and the Spiders, although, so far as the diverticula are concerned, it corresponds to the second apophysis in these groups, inasmuch as it juts up between the diverticula which extend towards the third and fourth appendages (first and second pairs of legs). The third apophysis, the homologue of the second in the other groups, instead of rising behind the first diverticulum, emerges behind the second with the anterior branch of the fourth, while the posterior branch of the fourth (numerically the fifth) similarly appears behind the third diverticulum in company with the sixth apophysis.

Or if, for the sake of clearness, we assume that there were originally five diverticula representing the five postoral somites. and four apophyses belonging to the first four of these somites, and that the diverticulum passed in front of the apophysis in each somite, as is the case in the Spiders and Thelyphonidæ; and further, if we assume that the two additional apophyses in *Phrynus* have been derived by fission from those of the first and third postoral somites, the differences between *Phrynus* and the others with regard to the arrangement of diverticula and apophyses may be briefly stated as follows:—The apophysis of the second postoral somite has moved backwards behind the diverticulum of the third postoral somite, its place behind its appropriate diverticulum being taken by the outer branch of the first apophysis, and the extra branch of the third apophysis has similarly shifted back behind the diverticulum of the fourth postoral somite.

Laurie describes the stomodæum as "a narrow tube extending from the mouth to a little behind the brain. In front of the brain there are attached to it powerful muscles running dorsally to be inserted in the carapace behind the median eyes. Lateral muscles are also present in this region, which no doubt has a suctorial function, though there is no sign of any dilatation to form a sucking-stomach. Close behind the brain, and just in front of the junction between the stomodæum and the mesenteron, are inserted some more muscles which also pass dorsally to the carapace. The anterior part of the mesenteron is dilated to form a sort of stomach as in *Thelyphonus*. The dilatation seems to take the form of a single pair of lateral outgrowths, very similar at this [embryonic] stage to those of the 'liver.' A small median ventral outgrowth is also present, and reminds one of the median processes in *Thelyphonus*."[1]

These observations were based upon embryos. The only discrepancy between this description and that given above of the adult, is the attachment of the muscles of the pre-cerebral sucker to the under surface of the carapace.

Blanchard's description, based upon the adult, makes no mention of the muscle which passes dorsally from the pre-cerebral sucker

[1] Journ. Linn. Soc., Zool. xxv. p. 32 (1894).

to the median vertical entosclerite; nor of the presence of a post-cerebral sucker in the foregut, worked by lateral muscles attached to the anterior border of the entosternite and by a dorsal muscle extending to the underside of the carapace. Nor is the forward extension of the stomach on each side of this ascending muscle and the descending aorta to form a channel, through which arise also the two obliquely directed tendons of the entosternite, mentioned. Since these structures are not represented in the figures, it is permissible to suppose they were overlooked.

5. On Recent Additions to the Batrachian Fauna of the Malay Peninsula. By A. L. Butler, F.Z.S., Superintendent of the Sudan Game Preservation Department, Khartoum.

[Received June 9, 1902.]

The papers by Captain Stanley S Flower on the Reptiles and Batrachians of the Malay Peninsula, published in this Society's 'Proceedings' during 1896 and 1899, have been so valuable to local workers, that it may be useful to bring the list of Batrachians of the Peninsula up to date by enumerating the species obtained for the first time from that region since the appearance of Captain Flower's second paper.

In that list (P. Z. S. 1899, pp. 885 *et seq.*) 45 species of Batrachians are recorded from the Malay Peninsula, including *Megalophrys montana* Kuhl, mentioned somewhat doubtfully in a note, but since obtained again by the "Skeat Expedition," and two species, *Rana jerboa* Gthr., and *Nectes subasper* Tschudi, mentioned in the Addenda.

To bring the list up to date, the following 13 species have now to be added, carrying the total number up to 58.

Four of these species, *Rana livida*, *Rana doriæ*, *Rhacophorus bimaculatus*, and *Leptobrachium pelodytoides*, have not been hitherto recorded from the Peninsula.

Fam. Ranidæ.

1. Rana signata Gthr.

Rana signata Laidlaw, P. Z. S. 1900, p. 886.
Locality. Gunong Inas ("Skeat Expedition").
Previously known from Borneo.

2. Rana livida Blyth.

Rana livida Boulenger, Faun. Ind., Rept. p. 462.
Locality. Larut, Perak (L. Wray). Identified by Mr. Boulenger.
Previously known from Himalayas and Assam to Tenasserim.

3. Rana lateralis Blgr.

Rana lateralis Laidlaw, P. Z. S. 1900, p. 886.

Locality. Kuala Aring ("Skeat Expedition").
Previously known from Burmah.

4. Rana doriæ Blgr.

Rana doriæ Boulenger, Ann. Mus. Genova, (2) v. 1887, p. 482, pl. iii. fig. 1; ib. xiii. 1893, p. 328, pl. viii. fig. 1; Faun. Ind., Rept. p. 447.

Locality. Larut, Perak (L. Wray). Identified by Mr. Boulenger.
Previously known from Karin Hills, Tenasserim, Mergui.

5. Rhacophorus bimaculatus Blgr.

Rhacophorus bimaculatus Boulenger, Cat. p. 90; Faun. Ind., Rept. p. 472; Ann. Mus. Genova, (2) xiii. 1893, p. 339.

Locality. Larut Hills, Perak (L. Wray). Identified by Mr. Boulenger.
Previously known from E. Himalayas, Karin Hills, Khasi Hills.

6. Ixalus larutensis Blgr.

Ixalus larutensis Boulenger, A. M. N. H. (7) vi. Aug. 1900, p. 187.

Locality. Larut Hills, Perak, 4000 to 4500 ft. (A. L. Butler). Type specimens.

7. Ixalus vermiculatus Blgr.

Ixalus vermiculatus Boulenger, A. M. N. H. (7) vi. Aug. 1900, p. 187.

Locality. Larut Hills, Perak, 4000 ft. (A. L. Butler). Types.

Fam. Engystomatidæ.

8. Microhyla inornata Blgr.

Microhyla inornata Laidlaw, P. Z. S. 1900, p. 887.

Locality. Bukit Goah, near Biserat, Jalor ("Skeat Expedition").
Previously known from Sumatra, Borneo, and Siam.

9. Microhyla annectens Blgr.

Microhyla annectens Boulenger, A. M. N. H. (7) vi. Aug. 1900, p. 188.

Locality. Larut Hills, 4000 ft. (A. L. Butler). Types.

10. Microhyla butleri Blgr.

Microhyla butleri Boulenger, A. M. N. H. (7) vi. Aug. 1900, p. 188.

Locality. Larut Hills, Perak, 4000 ft. (A. L. Butler). Type.

Fam. BUFONIDÆ.

11. BUFO JERBOA Blgr.

Bufo jerboa Laidlaw, P. Z. S. 1900, p. 889.

Locality. Gunong Inas ("Skeat Expedition").

Previously known from Borneo.

Fam. PELOBATIDÆ.

12. LEPTOBRACHIUM PELODYTOIDES Blgr.

Leptobrachium pelodytoides Boulenger, Ann. Mus. Genova, (2) xiii. 1893, p. 345, pl. xi. fig. 3.

Locality. Larut Hills, Perak (L. Wray). Identified by Mr. Boulenger.

Previously known from Karin Hills.

13. LEPTOBRACHIUM HETEROPUS Blgr.

Leptobrachium heteropus Boulenger, A. M. N. H. (7) vi. Aug. 1900, p. 186.

Locality. Larut Hills, Perak, 3500 ft. (A. L. Butler). Type.

Note.

RANA LATICEPS Blgr.—I have examined the frogs from Gunong Kledang, Perak, which Dr. Hanitsch recorded (Rep. Raffles Library & Museum, 1898) as *R. laticeps*, and I find they are in reality *R. hascheana* (Stol.). The claim of *R. laticeps* to a place on the Peninsula list depends, therefore, on a single specimen in the British Museum from Malacca (Mr. Hervey), and on Captain Flower's not quite positive identification of a specimen in bad condition in the Raffles Museum, from the same locality.

6. On some new Species of Earthworms belonging to the Genus *Polytoreutus*, and on the Spermatophores of that Genus. By FRANK E. BEDDARD, M.A., F.R.S.

[Received June 3, 1902.]

(Text-figures 46–54.)

The specimens which I deal with in the present communication form a part of the collection of these Annelids at the British Museum. Dr. Ray Lankester has been so good as to permit me to study these worms; and to him, as well as to Mr. E. A. Smith with whom I have corresponded on the matter, my thanks are due. The majority of the specimens were collected by Mr. S. L. Hinde in the Kenya District, at an altitude of 4000–4800 feet; a number of others, which also prove to be of considerable interest, were collected by Mr. Stuart Betton, in Lagari, British East Africa. The genus is limited in its range to Equatorial

East and Central Africa. There are at present twelve species known, of which eleven are characterized (from the original descriptions by himself and by myself) by Dr. Michaelsen in his "Oligochæta" which forms Lieferung X. of 'Das Tierreich'[1]. To these I have recently added a twelfth species, also collected by Mr. Hinde[2]. I have now some observations to record upon new species. The first of these I shall name

(1) Polytoreutus kenyaensis, n. sp.

This new species is one of the smaller forms, and agrees in its dimensions with *P. cæruleus* and *P. violaceus*. The large series of specimens which I have examined vary somewhat in dimensions; 100 mm. in length by 5 mm. in breadth were the measurements of an average specimen among the larger ones. The species is evidently a darkly coloured one; in the spirit the specimens were purplish brown dorsally. The prostomium is epicheilous, extending about halfway across the buccal segment.

The clitellum is completely developed round the body and embraces segments xiv. xvii. inclusive with a portion of xviii. and sometimes of xiii.

The setæ, as is usual in this genus, are at unequal distances. The two setæ of the ventral couple are wider apart than are those of the lateral couple. The nephridiopores are only plainly visible upon the clitellar segments; they lie close to the anterior margin of the segment in a line with the ventralmost of the two lateral setæ.

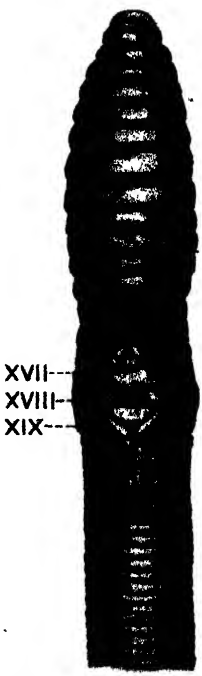
The oviducal pores are obvious upon the xivth segment; they lie near to the posterior boundary of that segment and a little ventrally to the nephridiopores.

The most striking external feature of this species is shown in the accompanying drawings (text-figs. 46, 47). The male and female pores (to the description of which I shall return presently) lie on an area which is enclosed within a raised and lip-like fold which commences upon the sixteenth segment in front, and is continued back for a variable number of segments. Anteriorly upon the xvith segment and close to the front boundary of this segment, the folds of the right and of the left side nearly or quite coalesce; they then diverge to enclose the male pore and become again approximated upon the xviiith segment and behind this pore. The larger spermathecal pore pushes the folds still further apart. Two or three segments behind this point the right and left folds again approach each other, but much more nearly, and they may even come into contact upon the last segments where they are developed, leaving merely a groove to indicate their original distinctness. This groove is generally closed posteriorly by an unpaired swelling of the integument. The whole area has thus very much the contour of a violin. I examined altogether

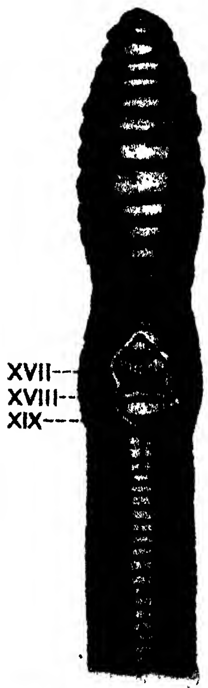
[1] Berlin, 1900, p. 412.
[2] "On some Earthworms from British East Africa, &c.," P. Z. S. 1901, i. p. 336.

75 fully mature examples of this species and found some variations in the extent of these lateral folds surrounding the genital area. The prevalent arrangement was that the area ended upon the xxivth segment; 29 specimens exhibited this character. But in nearly as many (24) these folds ceased to exist upon the xxiiird segment. In 18 examples the folds were more extensive, reaching to the xxvth segment. The extreme in this direction was shown by one specimen only, where the groove extended as far as the xxvith segment. On the other hand, in three specimens this genital area stopped short at segment xxii.

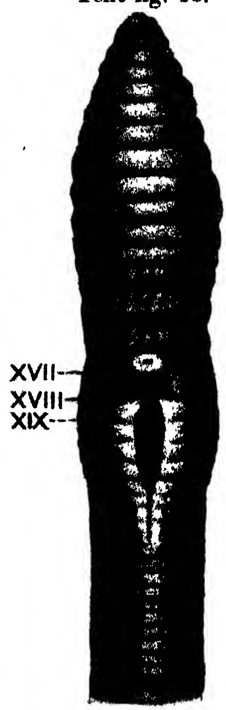
Text-fig. 46.



Text-fig. 47.



Text-fig. 48.



Text-fig. 46.—Ventral view of anterior segments of *Polytoreutus kenyaensis*.

Text-fig. 47.—Ventral view of anterior segments of an individual of *Polytoreutus kenyaensis*, with shorter perigenital area.

Text-fig. 48.—Ventral view of anterior segments of *Polytoreutus montis-kenyæ*.

The segments which bear the pores are numbered.

The single and median male pore is upon segment xvii.

The single and median spermathecal pore is wider from side to side and lies upon the boundary line of segments xviii./xix.

As to the internal structure, it is mainly the female parts of the generative system which show differences from other species.

The septa dividing segments v./xi. are thickened. The dorsal vessel is single, and the last pair of hearts are in segment xi.

The gizzard lies in segment v. The system of calciferous glands appears to be quite as in other species.

In the xith segment are the dilated chambers which form the commencement of the single pair of sperm-ducts.

The sperm-sacs of *Polytoreutus kenyaensis*, as is the case with all other species of the genus, are but a single pair and are of very considerable length. In a worm measuring 9 mm. in length the sperm-sacs were 15 mm. long. As is the case with many other species of the genus, the sperm-sacs are divided into two regions: the anterior half is a thin slender tube, while the posterior half of each sperm-sac is swollen and deeply constricted where it passes through the septa. This latter region begins at about the xxivth segment and extends to the xxxviiith. For three or four segments the slender sacs which form the anterior part of the sperm-sacs are also constricted where they traverse the septa. Latterly, the sperm-sacs show no signs of division into two sacs, they are completely blended for a tract which extends some little way forward from the posterior end.

The spermiducal glands are tubular and straight or a little coiled. I did not notice any marked division into two regions as in the spermiducal glands of *P. gregorianus*. There are here and there slight constrictions along the walls which produce irregular bulgings of the tube. In one case, and place, this bulging was so marked that the permiducal gland ended in a bifid extremity. The large bursa into which both these glands open is more or less circular in contour.

The spermathecal apparatus appears to differ from that of any other species in that it has no diverticula. It commences anteriorly not far from septum xiii./xiv. and pursues a straight course to its point of opening on to the exterior between segments xviii./xix. It is a narrow tube and flattened against the ventral body-wall, being overlaid by the nerve-cord; at the posterior end it is wider for a short space before its external orifice. Anteriorly the sac ends blindly in a rounded extremity. Into this open the two oviducts directly, and not through the intermediary of diverticula of the sac as in other species of the genus. The oviducts are slightly coiled and, as usual, thick-walled and present a very different appearance from the spermathecal sac into which they open. Traced in the opposite direction, the oviducts pass to the exterior through a rounded thick-walled chamber which Dr. Michaelsen has called the "Eitrichterblase," to which is appended a receptaculum ovorum. The latter is very much larger than the Eitrichterblase from which the oviduct runs to the external pore. Several chambers packed with spermatozoa ("Samenkämmerchen" of Michaelsen) are appended to the oviduct close to its exit from the receptaculum, as in many but not all species of *Polytoreutus*. I may observe that the oviduct is ciliated throughout, not merely that portion of it which passes from the receptaculum to the

exterior. As to the region which opens into the spermathecal sac, it seems to be an unnecessary periphrasis to call it, as Dr. Michaelsen does, a "Verbindungsschlauch." It is, to my mind, unquestionably the oviduct and corresponds exactly to that portion of the oviduct which in other Eudrilids (*e. g.* in *Stuhlmannia* [1]) opens directly into the spermathecal sac. Its cells are cubical and ciliated, and totally different from the long thin nonciliated cells which line the spermathecal sac. Furthermore, there is no transition between the two kinds of cells that I could discover; and finally the oviduct opens by a slightly dilated mouth freely into the interior of the sac. This is, I take it, the oviducal funnel. I am inclined from these additional facts to add to the definition of the Eudrilidæ that the oviduct is characterized by the possession of two funnels, one of which opens into the receptaculum ovorum and the other into the spermathecal sac. The Samenkämmerchen are, as Michaelsen their discoverer has pointed out, diverticula of the oviduct packed with spermatozoa arranged in a regular fashion. I am disposed to consider these diverticula as corresponding to the single diverticulum upon the oviduct which is to be found in *Hyperiodrilus*, *Heliodrilus*, and *Alvania*. Spermatozoa have not, however, so far been found to exist in the latter. I found spermatophores in the spermathecæ, the description of which I postpone for the present.

(2) Polytoreutus montis-kenyæ, n. sp.

This species has a considerable similarity to the last, which is chiefly due to the fact that the genital area is surrounded by a raised ridge not unlike that distinctive of *Polytoreutus kenyaensis*. The two species are nevertheless perfectly distinct. There are both external and internal differences of structure. *Polytoreutus montis-kenyæ* is, in the first place, a smaller and more slender species than its nearest ally. It has a length of 68 mm. and a diameter of 4 mm. In its colour (in spirit), form of prostomium, arrangement of setæ, position of nephridiopores, the present species appears to agree exactly with *P. kenyaensis*. The clitellum is also much the same; it always occupies segments xiv.–xvii., and occasionally strays a little way on to segments xiii. and xviii. Externally this species is to be distinguished from *P. kenyaensis* by the position of the male pore and by the perigenital area. The male pore lies intersegmentally between xvii./xviii. This fact could be positively ascertained only upon immature specimens, of which there are a good many. In the fully adult worm, the orifice in question is borne upon a smooth conical projecting papilla, more conspicuous in some individuals than in others, but always obvious. The actual orifice when particularly conspicuous is circular in outline. This papilla shelves down into the perigenital ridges, which in this species do not extend further

[1] Beddard, P. Z. S. 1901, vol. i. p. 364, text-fig. 87, *o.d.*

forward than the xviith segment. This, as will be seen from a comparison of the drawings exhibited (*cf.* text-figs. 46 and 48, p. 192), is a striking difference between *Polytoreutus montis-kenyæ* and *P. kenyaensis*. The male orifice itself is not so conspicuous as in *P. kenyaensis*, and the female pore is much less so; it lies between segments xviii./xix.

The outline of the perigenital ridge is not so complete as in the last species. Anteriorly it is oval in contour, leaving a considerable ventral area of that shape between the two sides. The right and left folds approach each other gradually, and about the xxiiird segment are in practical contact, a furrow only being left between them. The shape of the genital area is thus more like a racquet than a violin. As I have already explained in the case of *P. kenyaensis*, the perigenital ridges of the present species are subject to some variation in their extent. But the mean about which the variation plays is a segment further back than in *P. kenyaensis*. In 26 individuals the ridges ended either upon segment xxv. or upon segment xxvi. Ten of these I refer to the latter category; but it is a little difficult to be accurate in drawing a hard and fixed line, since the groove sometimes ended upon the middle of the xxvith segment. I found no (mature) individual in which the genital area was of less extent; but in *one* specimen only it reached to the end of segment xxvii.

Text-fig. 49.

Ventral view of genital segments of *Polytoreutus montis-kenyæ*.
P, white cushion-like thickening.

The only other external character to which I have to call attention, is the very occasional presence of a white cushion-like thickening of limited extent in the ventral median line of segments xx. and xxi. I only observed this character to be well

developed in one individual which was not fully mature (text-fig. 49).

The internal anatomy of the genus *Polytoreutus* appears, so far as present observations go, to offer but little variation in the characters of the alimentary canal and the vascular system. I find that up to the xiith segment the structure of the present species is quite like that of its nearest ally. The sperm-sacs, moreover, are constituted upon exactly the same plan. In two specimens, one of the present species and one of *P. kenyaensis*, which I divided longitudinally and placed side by side for comparison, the dilated terminal region of the sperm-sacs reached back to precisely the same segment, *i. e.* the xxxviiith. There is, however, naturally some variation in the extent of these sacs.

The spermiducal glands of the present species are relatively larger than those of *Polytoreutus kenyaensis*; otherwise their contours are much the same. They do not, however, open directly into a bursa propulsoria as in that species. The gland ends, in fact, in a duct of rather narrower calibre; the ducts appear to join, and in any case the bursa propulsoria is insignificant in its dimensions. That this would prove to be the case, is really indicated by the external characters; the, comparatively speaking, inconspicuous male pore does not suggest a large muscular terminal sac such as is suggested by and co-exists with the wide and broad external male pore of *P. kenyaensis*. The two drawings exhibited herewith (text-figs. 50, 51, p. 198) show accurately the relative dimensions of the bursa propulsoria in the two species. That of *Polytoreutus kenyaensis* is fully twice the size of that of the present species. These differences are of specific value; they have nothing to do with relative maturity. In both cases, a number of segments following the median generative pores have a much thickened body-wall. The ventral region of integument thus increased in thickness corresponds to the genital area dealt with in describing the external characters of the two species. The drawing (text-fig. 50, A, p. 198) shows the pre-eminently glandular nature of this area in *P. montis-kenyæ*, where contorted whitish masses of glandular substance have largely invaded the thickness of the integument. It may be finally pointed out that the external orifice and the lumen of the bursa propulsoria in *P. montis-kenyæ* looks forward; while in *P. kenyaensis* the direction is at right angles to the longitudinal axis of the body of the worm. The most remarkable feature, however, about the male efferent apparatus of this species is the existence of a small forwardly directed diverticulum of the spermiducal gland. This diverticulum has exactly the same appearance as the main gland, but is of less calibre: it receives the sperm-duct at its free apex. It joins the main gland just where the latter passes into its duct. This structure is not, however, new to the genus. Dr. Michaelsen has already recorded in *Polytoreutus arningi*[1] a perfectly similar

[1] "Neue u. wenig bekannte afrikanische Terricolen," J.B. Hamb. wiss. Anst. xiv.

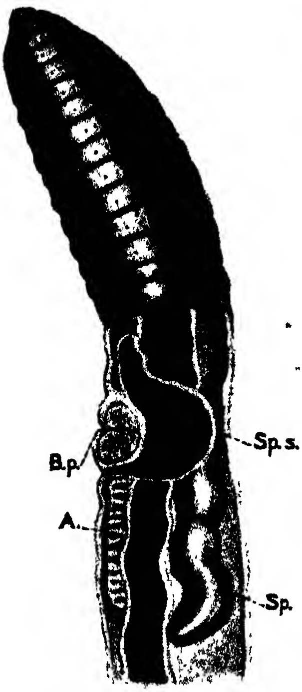
structure; but these two species stand apart in this character from the remaining species of the genus *Polytoreutus*.

This condition appears to me to throw some light upon the curious structure of the corresponding glands in *Eudrilus*. In that genus, as has been abundantly shown by others as well as by myself, the spermiducal gland of each side is really formed by the close lateral fusion of two tubes, the fusion being merely a close apposition and retention within the same muscular sheath. The lumina are distinct, and the sperm-duct opens into one only of the closely joined tubes. Moreover, one of the tubes is distinctly longer than the other. My own recent investigations upon the spermiducal glands in the young *Eudrilus* seem to show that the division of the spermiducal gland is a secondary matter, for it is single and with but one lumen in the immature worm. It may be, however, that in *Polytoreutus* an originally double spermiducal gland derived from some *Eudrilus*-like form has split into its two component halves which have acquired independence. The double character of the male orifices and the female reproductive organs in *Eudrilus*, point to its being a more primitive type of Eudrilid than the, in many respects, highly modified *Polytoreutus*. In the present species the minute structure of the two parts of the "prostate" is identical, and the sperm-duct becomes continuous with the lumen of the diverticulum about one third way down.

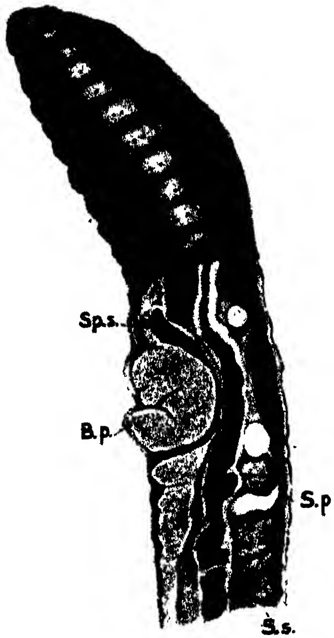
The female organs closely resemble those of *P. kenyaensis*. The spermathecal sac is single and median, and has no diverticula of any kind. At the posterior end it is, however, a little different from the spermathecal sac of the last species. The difference lies in the fact that the sac is humped up and bulged out a little way before the external orifice. Viewed laterally, the spermathecal sac is there **S**-shaped posteriorly. There is no question of diverticula. It is simply a dilatation of the sac itself. This region was packed with coagulated matter, which under the microscope was seen to consist entirely of coarse granules. I could find no trace of spermatophores. By the examination of several specimens I have convinced myself that the proximal widening of the spermathecal pouch of this species is a constant character, and distinguishes it from its ally *P. kenyaensis*. The contrast in this particular between the two species is clear from an inspection of the drawings exhibited (*cf.* text-figs. 50, 51, p. 198). Of this particular individual, I detached and made a series of sections of the anterior end of the spermathecal sac and of the egg-conducting apparatus. Though there were apparently no spermatophores in the posterior portion of the spermathecal sac, they were abundant anteriorly. The oviduct is furnished, as in the last species, with several diverticula lodging sperm. I have noted, however, the additional and interesting—if obviously to be expected—fact that free spermatozoa exist also along the course of the oviduct between the diverticula just referred to and the spermathecal sac. Their heads seem to be invariably in contact with the lining epithelium, the cilia of

which possibly attract them. I cannot therefore form an opinion as to the direction in which they were moving at the time of death. As in *P. kenyaensis*, the oviducts open straight into the median spermathecal sac at the two anterior corners.

Text-fig. 50.



Text-fig. 51.



Text-fig. 50.—Longitudinal section through genital segments of *Polytoreutus montis-kenyæ.*

A., ventral glandular area; *B.p.*, bursa propulsoria; *Sp.*, spermiducal gland; *Sp.s.*, spermathecal sac.

Text-fig. 51.—Longitudinal section through genital segments of *Polytoreutus kenyaensis.*

S.s., sperm-sac. Other letters as in text-fig. 50.

I have been able to note the histological characters of the epithelia at the point of contact. The sac is lined generally with a tall epithelium of granular appearance, the cells of which appear to break down at their free extremities to produce the granular matter with which the pouch is largely filled. At the slightly bulging corners (suggesting by their protuberance rudimentary diverticula of the median sac), where the oviducts open, the tall granular epithelium is underlain by a columnar epithelium which

is continuous with that lining the oviduct. At the sides this epithelium thins out and apparently disappears. Near to the orifice of the oviduct into the spermathecal sac, the tall granular cells disappear, so that there is a perfectly open oviducal funnel. At the actual opening of the funnel, the columnar cells are raised to form a lip surrounding the lumen. There can be no question therefore about the termination of the oviduct within the spermathecal sac in a funnel-like expansion. I could not, however, detect any cilia upon the epithelium.

(3) Polytoreutus bettonianus, n. sp.

Of this new species two individuals, of which one is fully adult, were collected at Lagari, British East Africa, by Mr. Stuart Betton. The worms were rather softened, so that the following account of their structure is not so full as it might otherwise have been.

The mature individual is incomplete at the posterior extremity; it measures 77 mm. by 5 mm. in diameter. The immature specimen is 93 mm. long. The colour (in alcohol) is of an uniform grey. The prostomium is procheilous, fitting into the concave anterior margin of the peristomial segment. The setæ show the usual arrangement met with in *Polytoreutus*. The clitellum occupies segments xiv.-xvii. entirely and about one-third of segments xiii. and xviii. The male pore is borne upon a prominent papilla and is intersegmental, xvii./xviii. The female pore lies between segments xviii./xix. There are no papillæ of any kind.

The alimentary tract and vascular system appear to be as in other species. The sperm-sacs of this species are unusual in their character. They are more normal speaking generally, but less normal for this particular genus *Polytoreutus*. In eight out of the twelve species already known and in the two species which have been dealt with in the present communication, the sperm-sacs commence as thin strands which pass back for a considerable distance before they acquire the more capacious dimensions usually associated with the sperm-sacs of earthworms. In *Polytoreutus bettonianus* the sperm-sacs are as wide at their commencement as they are in any part of their course. Coupled with this increase in diameter is a decrease in length. The sperm-sacs of the present species reach hardly further back than the point of opening of the spermiducal glands. The sperm-sacs are plump and sausage-shaped, of greater calibre than the spermiducal glands; they are marked by one or two deep constrictions. The two sperm-sacs are perfectly independent, and are not fused or even approximated posteriorly.

The spermiducal glands are about 14 mm. long; there is nothing remarkable in their form. Each gland is furnished with a narrower duct. A bursa propulsoria is practically absent. The female apparatus is constituted upon exactly the same plan as that of the two species just described. There is no bursa copulatrix. The spermathecal sac itself is single and median, without

any diverticula. Its calibre is rather greater than is the case with *Polytoreutus kenyaensis* and *P. montis-kenyæ*. Anteriorly the two oviducts enter it, and they are readily distinguishable from the pouch by their nacreous, indeed almost bronzy glitter, due, of course, to the thick muscular wall.

It may be convenient to embody the above-given descriptions in a short diagnosis of each of the new species of *Polytoreutus* dealt with in the present communication.

(1) **Polytoreutus kenyaensis**, n. sp.

Length 100 mm.; diameter 5 mm. Colour (in alcohol) purplish brown above. Prostomium epicheilous. Clitellum (xiii.) xiv.-xviii. Male pore xvii.; female pore xviii./xix. Genital area formed by two curved ridges meeting anteriorly on xvi. and posteriorly on xxiii.–xxvi. Sperm-sacs narrow and tubular anteriorly, wide and sacculated posteriorly, fused at extremity. Bursa propulsoria very large; spermiducal glands without duct. Spermathecal sac without diverticula; oviduct with sperm-holding diverticula; no bursa copulatrix.

Hab. Mt. Kenya region, Brit. C. Africa.

(2) **Polytoreutus montis-kenyæ**, n. sp.

Length 68 mm.; diameter 4 mm. Colour (in alcohol) purplish brown above. Prostomium epicheilous. Clitellum (xiii.) xiv.–xviii. Male pore xvii./xviii.; female pore xviii./xix. Genital ridges commencing at male pore and ending on one of segments xxv.–xxvii. Sperm-sacs narrow and tubular anteriorly, wide and sacculated posteriorly, fused at extremity. Bursa propulsoria very small; spermiducal glands with short anterior branch receiving sperm-duct and with slender duct. Spermathecal sac without diverticula; no bursa copulatrix.

Hab. Mt. Kenya region, Brit. C. Africa.

(3) **Polytoreutus bettonianus**, n. sp.

Length about 100 mm.; diameter 5 mm. Colour (in alcohol) grey. Prostomium procheilous. Clitellum xiii.–xviii. Male pore xvii./xviii.; female pore xviii./xix. Sperm-sacs of uniform, wide diameter throughout. Spermiducal glands with duct. Bursa propulsoria very small. Spermathecal sac without diverticula. No bursa copulatrix.

Hab. Lagari, Brit. E. Africa.

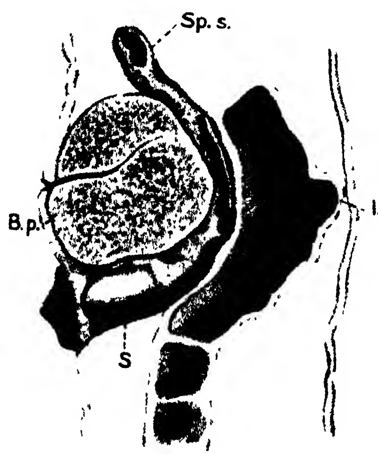
On the Compound Spermatophores of Polytoreutus.

In a communication made to this Society in 1901 [1] I dealt with the spermatophores of *Polytoreutus magilensis*, *P. violaceus*, and

[1] "On some Earthworms from British East Africa, &c.," Proc. Zool. Soc. 1901, vol. i. p. 340.

P. hindei, the only species in which, so far as I am aware, any structures of the kind have been met with or described. It may, I think, be admitted that in this genus *Polytoreutus* the spermatophores are very much like those of the Tubificidæ, and that they occur in two forms distinctive of different species of that genus. An examination of the species of *Polytoreutus* which I have named *P. kenyaensis* and *P. montis-kenyæ* has shown that the same kind of spermatophores exist, but not in great abundance, in the spermathecal sac. These spermatophores in *P. kenyaensis* are of the type characteristic of *P. magilensis*, but are smaller and more slender than in the much larger species *P. magilensis*. The spermatophores, when present, were found in the region of the spermatophore nearest to the external orifice. I never observed

Text-fig. 52.



Longitudinal section through the spermathecal sac and the adjacent region of *Polytoreutus kenyaensis*.

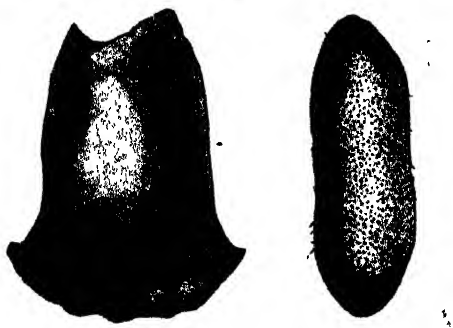
I., intestine; *S.*, spermatophoral case. Other letters as in text-fig. 50.

them to be so localized in position in the other species where these bodies occur. I failed to find in the present species, as I also failed to find in *Polytoreutus magilensis*, any indication that the spermatophores are immature forms of the same bodies in the species *P. montis-kenyæ*, *P. violaceus*, and *P. hindei*, in which two latter, it will be recollected, the chitinous sheath forming the wall of the spermatophore is much thicker. These additional facts, therefore, strengthen my earlier contention that there are two different forms of spermatophore in this genus. These facts, however, are not, so far as concerns *P. kenyaensis*, all that is to be said with respect to the spermatophoral apparatus in that species. In a few individuals out of a large number which I

examined, the wide mouth of the spermathecal sac was seen to be blocked by an irregularly crinkled mass of a brownish-yellow colour. The appearance presented was of a number of earth-particles adhering to the orifice in question. This, however, proved to be not the case; for it was possible to seize hold of the irregular mass with the forceps and draw it out of the spermathecal sac. It has then somewhat the form of an acorn (text-fig. 52) and was of about the size of a grain of millet.

When the spermathecal sac is cut open, the single spermatophore-case was seen to entirely fill the cavity of that sac, which is indeed stretched to contain it. The end of the case protruded a little way beyond the mouth, and this free end was the irregularly shaped brownish-yellow mass seen on an external inspection to

Text-fig. 53.

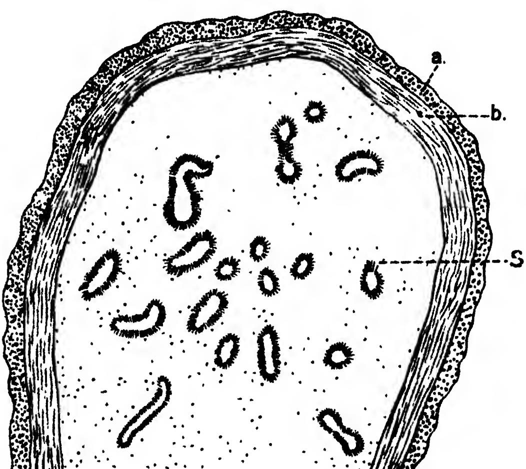


Spermatophoral case of *Polytoreutus kenyaensis*: (A) removed from spermathecal sac; (B) its contents (a mass of sperm-ropes) removed entire.

block the mouth of the sac. The part lying within the sac was smooth in appearance but hard to the touch; it gradually diminished in calibre to the end lying furthest from the mouth of the spermathecal sac. The exact measurements of the entire body were 2 mm. It seemed quite clear, even on a naked-eye inspection, that this body must be a spermatophore (text-fig. 53) (or perhaps a parasite) lying within the spermathecal sac. A study of its histological character appears to prove conclusively that this is the proper interpretation of the case. It is doubtful, however, whether it is permissible to call this body a spermatophore, seeing that the thin worm-like bodies which I have already described in this genus and in the present species seem to merit that name. We may, however, leave the consideration of this matter until after describing the histological characters of this case imbedded in the lumen of the spermathecal sac. The hard consistency of this body caused some little difficulty in procuring entire sections. However, I have not found it impossible to piece together mentally the

somewhat broken sections which were brought about by the brittleness of the walls. In longitudinal section (text-fig. 54) the case showed an oval contour, and it was nearly completely filled by a plug of matter with the following constitution:—The matrix, so to speak, of the no doubt fluid contents—fluid, that is to say, during life—was formed of granules of various sizes, which have not absorbed the borax-carmine with which the entire spermatophore had been stained. The spermatophore was not submitted for more than half an hour to the staining fluid, but in that time the spermatozoa within the case had been deeply tinted. But, as I have remarked, the granular matter was not so stained, and is therefore

Text-fig. 54.



Section through apex of spermatophoral case of *Polytoreutus kenyaensis*, highly magnified.

a, *b*, two layers of chitinous case; *S*, sperm-ropes imbedded in granular matter.

evidently to be regarded as a different substance from the imbedded spermatozoa. It is not, for example, composed of nucleated cells; or so at least it might be inferred from its non-staining qualities. The nature of this substance seems to me to be probably identical with that of the substance forming the walls of the spermatophore. I shall deal with the two together. Imbedded in this granular mass are the spermatozoa. These are not, however, loose and free from each other as in the case of the contents of some other spermatophores—for example, those of the genus *Stuhlmannia*. They consist of the regular bundles of spermatozoa which I have already referred to as "spermatophores." In sections these were

seen to be cut across in various directions, and it is plain therefore that they lie irregularly within the cavity of the spermatophore-case. The heads of the spermatozoa, where they are attached to the granular core, show a deep staining. The core itself is unstained. These sperm-ropes have no connection with the walls of the case which contains them. The latter hardly shows a definite structure in its walls, which appear from their hardness to be of a chitinous consistency. The region of the case which lies furthest away from the external orifice of the spermathecal sac has a, relatively speaking, thin wall which is divisible into two layers. The outermost layer is apparently softer than the inner layer and is darkly stained; it has a granular appearance. The inner layer is stratified longitudinally, in a direction, that is to say, parallel to the long axis of the case. It is but slightly stained, but it has a granular aspect; and here and there are darkly stained particles within its walls. At the base, the part which corresponds to the "cup" of the acorn, the walls are very thick indeed, so much so as to leave the barest chink in the way of a lumen leading to the exterior of the case. At the opposite extremity, I should say, the case is perfectly closed, and has no communication with the interior of the spermathecal sac. Where the walls are thick the process of cutting the sperm-case into sections has broken up the walls here and there into parallel strips running parallel again to the long axis of the case.

So much for the structure of the spermatophores and the enclosed sperm-ropes in *Polytoreutus kenyaensis*. In the allied *P. montis-kenyæ* the conditions were different. In none of the specimens which I examined—and these were numerous, though not so numerous as of *P. kenyaensis*—did I observe any large spermatophore lying within the spermathecal sac at the mouth. On the other hand, the interior of the spermathecal sac near to its blind end was occupied by a large number of spermatophores of the type already stated to exist in the species *Polytoreutus violaceus* and *P. hindei*. These spermatophores, that is to say, are of the same form as in *P. kenyaensis* and *P. magilensis*, but are larger and thicker, the increased size being mainly due to the fact that the heads of the spermatozoa are covered externally with a refracting and non-staining chitinous coat, which is absent in the more slender sperm-ropes of the other two species. I think that it will be convenient to retain the term sperm-ropes for the agglutinated spermatozoa of *P. kenyaensis* and *P. magilensis*, and to call spermatophores these more thoroughly finished off structures in *P. violaceus*, *P. hindei*, and *P. montis-kenyæ*. It seems to me also that the use of these different terms will serve to emphasize an essential difference between these two kinds of masses of agglutinated spermatozoa. In *P. montis-kenyæ* each mass of spermatozoa has its own chitinous case; in *P. kenyaensis* a large number of sperm-masses are enclosed within the same case. There is an analogy here with the cocoons of the Oligochæta. In some forms the cocoon contains but a single egg; in others a

considerable number are to be found in the same cocoon. Whether future investigation will show that *P. magilensis* has a large spermatophore like *P. montis-kenyæ* remains to be seen; but in the meantime I may point out that that species agrees with *P. kenyaensis* in the very conspicuous character of the spermathecal pore; while in those species with numerous and small spermatophores the external orifice of the sperm-sac is not so conspicuous.

In a former paper dealing with the spermatophores of this genus [1], I found myself unable to suggest the place of origin of these structures. I believe that I am now able to fix this with some probability. Were the spermatophores or sperm-ropes constructed by the activity of the spermiducal glands, the spermathecal sacs would only contain spermatophores or sperm-ropes already fully formed. This, however, is not the case; there are abundant and free spermatozoa, as I have already mentioned, in the diverticula of the oviduct and along the course of the latter up to and in the spermathecal sac itself. In my description of *Polytoreutus magilensis* I pointed out that free spermatozoa were to be found at the distal end of the spermathecal sac and not near to its mouth [2]. I have met with precisely the same thing in the present species. At the blind end of the spermathecal sac are numerous masses of free spermatozoa, generally in contact with a quantity of the granular matter which fills the pouch.

The facts lend themselves, indeed, to the hypothesis that the sperm from another individual gains access to the spermathecal sac, not by direct transference through the mouth of that sac, but through the oviducts, whose external pores are after all large and conspicuous, and quite as marked as are the external apertures of the spermathecæ in many other Oligochæta. At present, however, this view is not in the least pressed, for we are totally ignorant of the mode of copulation in these creatures. Again, if the spermathecal sac were a mere storage-house for the spermatophores, we should hardly expect it to be lined with the kind of epithelium which actually forms the lining of that chamber. The cells are long and granular, and at their free ends give off a loose granular secretion, into which indeed they appear to break up. In the spermathecal sac of an example of *Polytoreutus kenyaensis*, in which the mouth of the sac was plugged by no spermatophore, the sac was much occupied by actual cells which had wandered off from the lining epithelium. I take it that these later break down to form the granular matter already referred to. This granular matter in *P. montis-kenyæ* was seen to close round the spermatophores, and its appearance was quite indistinguishable from the chitinous (?) case of the small spermatophores. In some instances no demarcation could be drawn between the granular matter filling the pouch and that portion of it immediately surrounding

[1] "On some Earthworms from British East Africa; and on the Spermatophores of *Polytoreutus* and *Stuhlmannia*," P. Z. S. 1901, vol. i. p. 340.

[2] "Two new Genera and some new Species of Earthworms." Quart. Journ. Micr. Sci. vol. xxxiv. (n. s.) p. 252.

the mass of spermatozoa and forming the wall of the spermatophore. I cannot but think that the sac-secretion is responsible for the formation of the large case in which the sperm-ropes of *Polytoreutus kenyaensis* are contained. In support of this view, I may further cite the observations of Nasse[1], who found in *Tubifex* that the epithelium lining the spermatheca breaks down into a fluid or semi-fluid matter which may very possibly give rise to the coat of the spermatophore. I may finally point out that the existence of the large spermatophore of *P. montis-kenyæ* is on the whole not unlike the spermatophore of *Stuhlmannia*, the only other genus of Eudrilidæ in which up to the present spermatophores have been described. There are differences in detail, but in both the case is thicker at its open end, which lies next to the orifice of the spermathecal pouch, and the walls show a granular structure, suggestive of their origin from the breaking-down of the cells which constitute the lining membrane of the spermathecal sac.

Note on the Ovaries of Polytoreutus.

Although the ovaries in this genus have been already discovered by Michaelsen, there remain a few points connected with their relation to the efferent apparatus which have not yet been cleared up; at any rate, the descriptions of Dr. Michaelsen do not quite apply to the species which I have studied. The observations which I now record were made upon immature examples of *Polytoreutus montis-kenyæ* or of *P. kenyaensis*. In any case, the examples were collected with these two species and preserved in the same bottle with them. The possibility exists that they are the young of another species. I am not aware that this point can be settled. The earliest suggestion of the position of the ovary proves to have been wrong. Michaelsen[2] located it in the end of the diverticulum of the spermathecal sac, where the latter communicates with the oviduct. The next description of this part of the reproductive system was by myself[3], and is, as I now believe, not wholly correct. In *P. violaceus* some "small rounded cells" were noted in a sac attached to the spermathecal pouch where it comes into contact with the septum dividing segments xiii./xiv. As none of the cells were mature, it was impossible for me to be certain that this heap of cells was really the gonad; and I did not succeed in observing any connection of the sac involving the ovary with other regions of the egg-conducting apparatus. The small sac, containing what were presumed to be germinal cells, was connected with the septum by a strand of fibrous tissue. So far, therefore, the description was in agreement with that of

[1] "Beiträge zur Anat. der Tubificiden." Inaug.-Diss., Bonn, 1882.

[2] "Beschreibung der von Herrn Dr. Fr. Stuhlmann auf Sansibar und dem gegenüberliegenden Festlande gesammelten Terricolen," JB. Hamb. wiss. Anst. ix. (1) p. 39.

[3] "A Contribution to our Knowledge of the Oligochæta of Tropical Eastern Africa," Quart. Journ. Micr. Sci. xxxvi. (n. s.) p. 265.

Michaelsen [1], save that the gonad cells, instead of being within the spermathecal sac, were in a special sac closely adpressed to its walls. The next description of this gonad is by Michaelsen. In an account of several new species of the genus, Michaelsen has put on record certain facts about the ovary and its relations to other parts of the generative system. This paper contains the first positive and undoubted description of the ovary itself. In *P. usindjaensis* there is a sac ("Ovarialblase") attached to the loop of the oviduct, which Michaelsen has termed the "Eitrichterblase"; in the cavity of this are germinal cells, some of which are nearly mature ova. This is plainly shown in his figure [2]. As to the connections of this sac, the author expresses himself as follows:—"Das durch das Ovarium fast ganz erfüllte Lumen der Ovarialblase setzt sich in einen Kanal fort, über dessen inneres Ende ich mich nicht ganz genau orientiren könnte. Entweder tritt der Ovarialkanal in das Lumen der Eitrichterblase ein, nahe der Stelle, an der auch der Kanal des Receptaculum ovorum in dasselbe einmündet, oder vereint sich auch direkt mit diesem letzteren Kanal." It should be added that Dr. Michaelsen also figures a strand of connective tissue, as he has already done in *P. cæruleus*, attaching the ovarian sac to the parietes. In *P. kirimaensis* the conditions appear to be a little different. The ovary is contained in a narrow sac, which communicates by a narrow duct with the branches right and left of the spermathecal sac, near to where the oviduct also opens into that sac.

P. arningi is again different. In this species [3] there are apparently huge ovarian sacs which communicate medianly with each other. These narrow towards the septum xii./xiii., and it is here that Michaelsen would place the ovaries, though he was unable to bring forward any exact evidence of the existence of these gonads. No communication was traced between the ovarian sacs and any other part of the egg-conducting sacs and ducts.

It appears, therefore, that there are some differences between the various species of this genus *Polytoreutus* in respect of the relation of the ovaries to the rest of the female generative system. These differences may be possibly referred to two categories; and if so, it may be ultimately desirable to subdivide the genus. For in the species which possess a bursa copulatrix one arrangement prevails, and in the rest, as it appears to me, another. It is especially to the latter that I wish to draw attention in the present communication. I find that in the species examined by myself, the gonads and the ducts are probably to be compared exactly with the species *P. violaceus*, *P. cæruleus*, and *P. usindjaensis*. If this be so, then the ovary has not, up to the present, been discovered in those species. I have examined two stages in the development of the gonads and their ducts in *Polytoreutus*, one of which is

[1] "Die Regenwürmer Ost-Afrikas," in 'Deutsch-Ost-Afrika,' p. 16 &c.
[2] *Loc. cit.* pl. i. fig. 10.
[3] "Neue und wenig bekannte afrikanische Terricolen," JB. Hamb. wiss. Anst. xiv. p. 56.

much younger than the other, though outwardly no differences were to be detected. In the youngest stage the ovaries are plain, and completely fill two sacs situated on either side of the nerve-cord and at some little distance from it. These sacs are evidently those which Michaelsen discovered in *P. kirimaensis*. They also correspond exactly to the similar sacs in *Eudrilus*, in some young stages of which the sacs in question are closed sacs and have no outlet; later, of course, as is well known, they communicate with the spermathecal sac. Furthermore, these ovarian sacs, as they may be conveniently termed, correspond exactly to sacs involving the testis of each side in segment xi. I shall deal more at length with the points of likeness presently. Into each sac opens the oviduct by a conspicuous funnel, which has precisely the relations to the ovarian sac that the sperm-duct funnel has to the testicular sac (seminal sacs, sperm-reservoirs) in the same worm. Moreover, the course of the oviduct, which in this young stage has not reached the exterior, is exactly similar to the course of the sperm-duct. In both cases the funnel opens into the sac towards the centre of the body, and the duct bends sharply upwards and ceases at the body-wall at a precisely corresponding spot. The ovarian sac is not only continuous with the funnel of the oviduct. Its lumen is perfectly continuous with that of the spermathecal sac; the latter, however, in this very young specimen, is in a state of immaturity. It consists of a median sac as usual which contains no lumen; it is of inconspicuous dimensions, and runs for a short way beneath the nerve-cord. Its lateral branches, as has been said, open into the ovarian sac, and these branches have therefore for a certain distance a lumen. The development of the spermathecal sac is then, as it appears, from before backwards. I could find no trace of a receptaculum ovorum as distinct from the chambers of a cœlom already mentioned; and in any case the packing of the ovarian sac with a plug of germinal cells and developing ova shows that the time for the transference of the latter to a receptaculum was not yet ripe, and none of the ova were approaching maturity.

The existence of but one funnel seems to show that the existence of the funnels in the adult is simply a question of the division and pulling out of one branch of the single funnel. Furthermore, the fact that the ovarian sac communicates freely with the spermathecal sac, and that the receptaculum ovorum is formed later, shows that the communication in the adult between the ovarian sac and the one or the other of these two sacs is only a difference of secondary importance due to the different times at which the several cavities cease to communicate with each other. In the older stage, the relations of the various parts of the egg-conducting apparatus were further advanced and naturally different. The ovarian sac contained no ova or germinal cells at all; these are transferred *en masse* to the receptaculum, probably as the latter is formed. But the sac itself is quite evident, and communicates by a narrow chink, not at all conspicuous, with the

egg-sac. There is also an outgrowth of the ovarian sac into the thick muscular walls of the oviduct, to form a cavity which is that figured by Michaelsen in *P. usindjaensis* [1], and which is therefore, as I think, not the "Ovarialblase." This sac does not in its turn communicate with either the receptaculum or the spermathecal sac. I take it, however, to be—but this is purely theoretical—the part of the originally single cavity which is in communication with the spermathecal sac, the communication being cut off as the latter grows. There is in addition another comparison that may be made. In the case of the male organs the testicular sacs (seminal reservoirs) are, as I have mentioned, the exact homologues of the ovarian sacs, and both of them communicate with each other. The long sperm-sacs arise as an outgrowth of the septum, and their cavity communicates, not with the general cœlom of segment xi., but with the interior of the seminal reservoirs, which at that point are in contact with the posterior wall of their segment. The orifice of communication is a minute one, and immediately median of it is an ingrowth of the testicular sac into the thickness of the very thick septum which divides segments xi. and xii. The appearance of this prolongation of the testicular sac is exactly that of the prolongation of the ovarian sac just referred to; and I cannot help considering that both cavities are homologous. It would then possibly be a vestige of the spermathecal apparatus appended to the female system, the receptaculum of the latter being of course represented by the sperm-sacs. I would reiterate, however, that this is merely a suggestion. But that there is the actual likeness is a fact. Dr. Michaelsen [2] has figured a strand of "connective tissue," attaching the thickened muscular walls of the oviduct to the parietes of segment xiii. This structure exists in the worm examined by myself, but it traverses the wall of the xiiith segment and is attached to the posterior wall of segment xii.

It is not, as it might be supposed to be, a vestige of the canal connecting the cavity of the ovarian sac with that of the other parts of the egg-conducting apparatus. It is simply a thickening in the muscular attachments of the oviduct to the septa, comparable—I take it—to the "tendons" which tie the septa of this and other earthworms to the parietes: the muscular and heavy oviduct requires apparently some such fixed point. I may remark that in the worm whose immature reproductive organs I have just dealt with were germinal cells some way down the spermathecal sac, thus showing that there must have been in this specimen a communication between the ovarian sac and the spermathecal sac such as exists in younger stages. A final point to which I desire to draw attention is the fact that in the young stages the median spermathecal sac has two lateral branches, one on each side, into which the oviducts open on the one part. In the adult worm, as I have already mentioned, the spermathecal sac has no branches,

[1] "Regenwürmer," in 'Deutsch Ost-Afrika,' pl. i. fig. 19.
[2] *Ibid.* pl. ii. fig. 20 bis.

but the oviducts open one on each side of the single median sac. The arrangement with lateral branches is the most common one among the species of the genus *Polytoreutus*; and it is interesting to find them recapitulated in the young of *Polytoreutus montis-kenyæ*, whose adults have not the branches in question.

7. On the Sponges collected during the "Skeat Expedition" to the Malay Peninsula, 1899–1900. By IGERNA B. J. SOLLAS,[1] B.Sc. (Lond.), Bathurst Student, Newnham College, Cambridge.

[Received May 15, 1902.]

(Plates XIV. & XV.[2])

These Sponges were kindly entrusted to me for description by Dr. S. F. Harmer, F.R.S. They were obtained by Mr. R. Evans, of Oxford, by shore-collecting in two localities:— "(i) Pulau Bidang, one of the Nine Islands group, off the coast of Kedah on the west coast of the Malay Peninsula, running N.E. from the Island of Penang; (ii) Great Redang coral islands off the coast of Trengganu State (S. of 5° 50′ N.), which again is S. of Kelantan, the largest of the East-coast States." Thus, being a shore collection, the majority of the species represented in it belong to the group Monaxonida; the remainder are Tetraxonia and Keratosa.

In dealing with the representatives of the simpler Monaxonida I have contented myself with mere description, leaving the species undetermined. In the present state of classification of these species this seems to be the only satisfactory course open to any worker not prepared to make an exhaustive study of all the species of a genus.

MONAXONIDA.

1. RENIERA sp. (Plate XIV. fig. 5.)

Sponge growing on the back of a crab, of which it conceals completely the dorsal view.

Consistency gelatinous. Measuring from 1 to 2 cm. across.

Spicules slightly bent oxeas, 0·075–0·090 × 0·003–0·004 mm.

Spongin abundant at the nodes of the spicular network. The mesh is square. Single spicules project vertically from the dermal membrane.

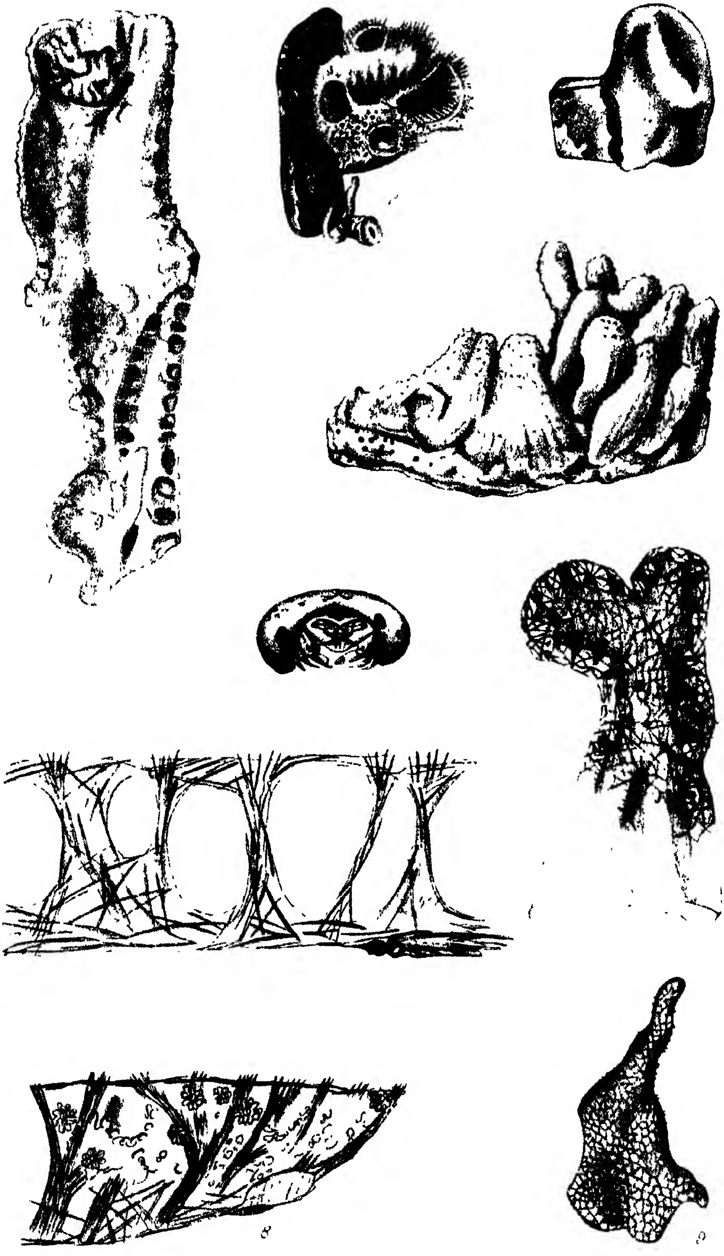
In one of the two specimens in the collection, but not in the other, there are a few multispicular strands in the otherwise very regular unispicular meshwork.

Pulau Bidang and Great Redang.

2. RENIERA sp. (Plate XV fig. 11.)

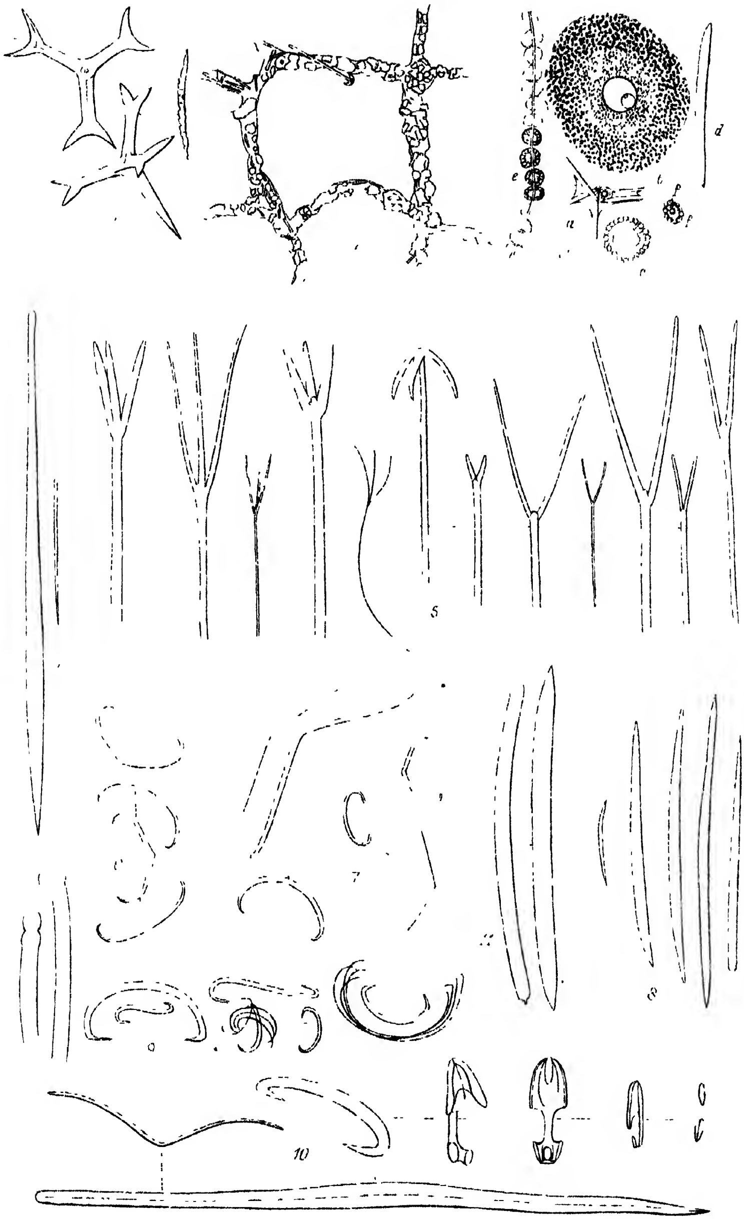
Sponge encrusting, growing on an encrusting Polyzoon and forming a thin sheet from 1–2 mm. in thickness. Oscula

[1] Communicated by Dr. S. F. HARMER, F.Z.S.
[2] For explanation of the Plates, see p. 221.



Edwin Wilson, Cambridge

SPONGES FROM THE MALAY PENINSULA



Edwin Wilson, Cambridge

SPONGES FROM THE MALAY PENINSULA

numerous, with raised margins, almost regularly arranged at distances of 5 mm. from one another. Pores large, conspicuous.

Skeleton composed of multispicular main fibres connected by a unispicular network. The main fibres run vertically, and their projecting distal ends raise the dermal membrane into small prominences.

Spicules, oxeas with gradually tapering ends or with rounded end from which a short point projects, 0·12–0·13 × 0·007–0·008 mm.

Great Redang.

3. Reniera sp.

A pink sponge forming irregular encrusting lobes. Oscula about 1·5–2 mm. in diameter.

Skeletal network with one or two spicules to the mesh. Dermal membrane smooth, pores fairly conspicuous.

Oxeas 0·10–0·11 × 0·0056 mm.

Embryos are present in the basal parts of the sponge, having a skeleton of scattered fine oxeate spicules.

Pulau Bidang.

4. Reniera sp.

Sponge ear-shaped, encrusting, thickest in the neighbourhood of the single large osculum, which is marginal. Compact, brittle. Colour, when fresh, grey.

Dermal membrane smooth. Pores visible, largely in rows. Main fibres multispiculate; spongin fairly plentiful.

Oxeas 0·098 × 0·002 mm. to 0·13 × 0·007 mm.

Pulau Bidang.

5. Reniera sp. (Plate XV. fig. 3.)

Two small fragments of a sponge of gelatinous consistency. Colour pinkish grey. Oscula from 1–3 mm. in diameter. Surface smooth, pores not obvious.

Spongin abundant, forming considerable swellings at the nodes of the unispicular mesh and occasionally completely enveloping the spicules along their whole length.

"Reniera filaments" and "chaplets" are present.

Spicules slender oxeas with somewhat blunt points, 0·08–0·09 × 0·003 mm.

Great Redang.

6. Reniera sp.

Sponge consisting of creeping branches attached at intervals, sometimes 5 mm. thick, sometimes forming quite a thin crust. Texture compact and resistant. Oscula 2 mm. in diameter with slightly raised thin margins.

Mesh unispicular, with some stout multispicular strands, having as many as 8–10 spicules on a cross section. Dermal membrane smooth, rather easily detached.

Oxeas bent, stout, 0·87–0·94 × 0·005 mm.

Pulau Bidang.

The specimen is bottled with two specimens (♂ & ♀) of a decapod crustacean without remark, presumably they were found sheltering under it.

7. Reniera sp.

Sponge tubular, creeping, branching and again anastomosing, swollen at intervals where it bears oscula of about 2 mm. in diameter. Pores large, conspicuous, and fairly evenly distributed.

The skeleton is rather irregular, with multispicular strands connected by a network which is not at all uniform, being either uni- di- or tri-spicular. The multispicular fibres raise the dermal membrane into minute conuli.

The tissues are permeated with black pigment-containing cells, which have a number of refractive granules over their surfaces.

Oxeas 0·14 × 0·007 mm.

Pulau Bidang.

8. Gellius centrangulatus, n. sp. (Plate XV. fig. 6.)

Sponge massive, fragile, attached by a broad surface. Dermal membrane easily removed. Oscula (?) in rows.

Skeleton a regular unispicular network with rather abundant yellow-brown spongin at the nodes. The spongin occasionally completely invests the spicules of the net. Here and there multispicular strands occur.

The interest of the species lies in its microscleres: besides sigmata of the usual form it possesses others with a central bend giving them an appearance very like that of a centractinate sigma that may perhaps be termed centrangulate (Pl. XV. fig. 6). These curious bow-like sigmata recur in *G. sagittarius* (Pl. XV. fig. 7)[1].

Oxeas 0·22 × 0·007 mm. The oxeas show frequent abnormality in that they bear lateral branches.

Sigmata 0·016–0·0195 mm. Centrangulate sigmata 0·0195 mm.

Great Redang.

9. Gellius sagittarius, n. sp. (Plate XV. fig. 7.)

Sponge attached, consisting of a more dense basal part and of numerous slender tubes arising from this.

In one specimen these tubes anastomose; in the second they are broken off and show no indication of how they were arranged.

Skeleton a more or less irregular network of oxeas, becoming especially so in the lower part of the sponge, where the arrangement of spicules is almost halichondroid.

Oxeas 0·3–0·35 × 0·01–0·013 mm.

Abnormalities among the oxeas are striking by their frequency. They consist in the possession of small branches at one end of the spicule, sometimes a single one is borne laterally, or there may be 3 or 4 or more pointing in various directions or forming a regular tuft.

[1] Since this paper was read the translation of Lundbeck's essay on the Sponges of the Danish Ingolf Expedition has appeared. Similar sigmata are there figured and described in *Gellius luridus*, n. sp.

Sigmata 0·012–0·016 mm.; centrangulated sigmata 0·016 mm.
Toxa: arms 0·025, 0·016; length 0·049 mm.
Pulau Bidang.

10. Esperella sulevoidea, n. sp. (Plate XIV. figs. 8 & 9 and Plate XV. fig. 10.)

Sponge creeping, attached at intervals, the attached parts forming thin disks.

The skeleton consists of short stout fibres of styles rising from the surface of support and almost at once breaking up into 3 or 4 compact branches which run to the dermal membrane, through which they pass, their ends forming little hispid patches on the surface which are visible to the naked eye. The dermal membrane contains a network formed of compact multispicular fibres. In the meshes of this main framework lie the various forms of microscleres. The rosettes of anisochelæ are mostly confined to the superficial parts of the sponge.

Spicules:

Tylostyles, with but slightly marked head, and with a peculiar undulating outline: 0·360 × 0·012 and 0·360 × 0·006 mm.

Sigmata 0·06–0·08 × 0·006 mm.

Toxa 0·5–0·14 mm.

Anisochelæ in rosettes, 0·05 0·06 mm.

Anisochelæ scattered, 0·033 mm.; 0·012 mm.

11. Biemma democratica, n. sp. (Plate XV. fig. 9.)

Sponge growing on a Lamellibranch shell and forming very thin encrusting sheets. The microscleres are in striking predominance over the megascleres, which might almost pass unnoticed. The microscleres are sigmata of many sizes, ranging from 0·01 to 0·08 mm.; they are frequently fascicled, and in this case they may be either linear or, as is more commonly the case, they may be of the same thickness as solitary sigmata of the same length. The few megascleres are tylostyles often bent rather sharply just below the head, or sometimes with a second swelling immediately succeeding the head.

Tylostyles 0·18 × 0·0025, head ·005; 0·26 × 0·06, thickness of head ·008; 0·56 × 0·006 mm., thickness of head 0·009 mm.

Sigmata 0·08 × 0·003 mm. to 0·01 linear.

I have included this species in the genus *Biemma* with some hesitation. Possibly it ought to form the type of a new genus.

Pulau Bidang.

12. Desmacella fortis Topsent.

Desmacella fortis Topsent, Revue Suisse de Zoologie, iv. 1896–7.

With this species from the Red Sea and Bay of Amboina are identified two specimens differing somewhat in external features. Each is greyish in spirit, but has coloured the spirit in one case violet, in the other pink.

The chief difference between the specimens is in the size and position of the oscula. In the violet-coloured specimen (which is

also the larger, measuring 8 cm. in height and 26 cm. in circumference, while the pink sponge is 7 cm. in height and 10 cm. in circumference) the oscula agree with Topsent's description. They are large—3-6 mm. in diameter,—confined to the upper surface of the sponge, and sometimes at the end of chimney-like projections which only need to fuse laterally with one another in order to give Topsent's dorsal crest. In the pink sponge the oscula are no more than 2 mm. in diameter, and are scattered on all the free faces of the sponge and lie quite level with the general surface.

Both specimens seem to have incorporated in themselves any foreign bodies lying on them. The canals of both are inhabited by 6-rayed Ophiuroidea in various stages of fission, or rather of regeneration following fission, one half of the disk and three arms being of much smaller size than the remaining three[1].

Styles 1·0-1·3 mm. × 0·04-0·047 mm. at their widest parts.

Sigmata 0·01 0·11 × 0·0055 mm., with many (10-12 were measured) intermediate sizes, differing in this latter particular from Topsent's description.

Trichodragmata 0·140 mm.

DESMACELLA sp.

Sponge about 15 mm. × 6 mm.

Probably a young specimen of *D. fortis* Tops.

Styles 1·05 × 0·03; 0·608 × 0·005 mm.

Sigmata 0·016-0·089 × 0·006 mm., with a few intermediates.

Trichodragmata 0·133 mm.

13. CIOCALYPTA MELICHLORA, n. sp. (Plate XIV. fig. 1 and Plate XV. fig. 8.)

The single specimen of this species is broken into about 20 pieces. It must have measured about 20 cm. in breadth and as much in height, and have consisted of a massive basal part breaking up distally into many flattened processes. Fortunately two of these processes have been preserved separately and are in a better condition. They show that the sponge possesses the structure formerly considered to be one of the diagnostic characters of the genus (for Thielé's views see Abh. Senckenb. Ges. xxv. 1900, p. 17); it has a central axis, in which the spicules run longitudinally; from this arise short columns containing spicules placed at right angles to the central axis and supporting the dermal membrane above a spacious subdermal cavity.

Colour in spirit whitish.

Spicules:—

Oxeas in great variety of size and form (Pl. XV. fig. 8), often inequiactinate, the large oxeas very broad in the middle and tapering gradually to fine points. They may be bent once or twice.

[1] See Bateson, 'Materials for the Study of Variation,' p. 433; and Lütken, Ann. & Mag. N. H. 1873. ser. 4, vol. xii. p. 323 (quoted by Bateson).

Oxeas 0·94 × 0·04 to 0·35 × 0·03 mm.; oxeas bent twice, 0·28 × 0·06 mm.

Styles 0·70 × 0·34 mm., occasional.

Still rarer are tornotes 0·88 × 0·032 and 0·56 × 0·02 mm.

Both the stoutest and the slenderest spicules are confined to the axis.

Pulau Bidang.

14. CIOCALYPTA RUTILA, n. sp. (Plate XIV. fig. 7.)

Sponge small, 25 × 8 mm.; very fragile, transparent, of a golden-brown colour.

Like that of *C. melichlora* just described, the structure is that typical of the genus in its narrower sense (Ridley & Dendy, Voyage of H.M.S. 'Challenger,' vol. xx. p. 173).

The axial column is of very light build, spongy and cavernous. The dermal membrane like that of *C. hyaloderma* (Ridley & Dendy, loc. cit. p. 174) is marked with little stars where the pillars of supporting spicules meet it.

Oxeas, with a few styles, 0·98 × 0·02 mm.

Pulau Bidang.

15. TETHYA INGALLI Bowerb.

Tethya ingalli Sollas, Voyage of H.M.S. 'Challenger,' vol. xxv. p. 431, pl. xliv.

Sponge spherical, attached, surface even. Cortex fibrous throughout, about 1 mm. thick, without intercortical cavities. Pores leading into narrow canals. Oscula similar to the pores.

Megascleres: Strongyloxeas 1·76 × 0·035; 1·40 × 0·03 mm.; 0·32 mm.; slender, abundant.

Microscleres: Spherasters 0·060-0·012 mm. Chiasters variable, 0·012 mm. Oxyasters 0·030-0·024 mm.

Kirkpatrick (P. Z. S. 1900) compares the spicule measurements of Christmas Island, Fremantle, and 'Challenger' specimens thus:—

	Strongyloxea.	Spheraster.	Chiaster.	Oxyaster.
Christmas I.	1·36 × 0·024	0·070	0·012	0·018–0·024
Fremantle ...	1·47 × 0·035	0·070	0·012	0·036
'Challenger' .	1·6–1·7 × 0·026–0·032	0·065–0·085	0·012–0·016	0·035–0·043

to which we may add

'Skeat' .	1·4–1·76 × 0·03–0·035	0·060–0·012	0·012	0·024–0·030

The specimen is gemmiferous, bearing several very young gemmules and one comparatively advanced (8 mm. in diam.), sunk in the parent tissues. In this gemmule microscleres resembling those of the adult are absent, but a number of globules are present—varying in size, the largest being 0·02 mm. in diameter. The largest globules are thus a little smaller than the centrum of the largest spheraster of the adult, and I supposed that the globule was the young stage of a spheraster. Since coming to

this conclusion I have seen Maas's paper (SB. Akad. Wiss. München, 1900, pp. 553–569). Maas describes the origin of spherasters from a pair of small calthrops, and I am hence at a loss to account for the globules unless we may suggest that the spherasters have more than one mode of origin.

Great Redang.

16. TETHYA MAZA Sel.

Tethya maza Selenka, Zeitschr. f. wiss. Zool. xxxii. p. 472, pl. xxviii. (1879); Sollas, Voy. H.M.S. 'Challenger,' vol. xxv. p. 440.

Sponge hemispherical. The curved surface is raised into low, more or less hexagonal bosses. In the depression between the raised areas are the pores leading into extensive, very regularly arranged, intercortical cavities.

The cortex is fibrous only in its inner part. Oscula absent or not distinguishable from the pores. Colour in spirit greyish white. Diameter of circular base 12 mm. The specimen is not gemmiferous.

Megascleres: Strongyloxeas 1·20 × 0·025 ; 0·8 × 0·013 mm.

Microscleres: Spherasters of many sizes, the maximum diameter is 0·056 ; centrum 0·025 mm.

Chiasters abundant in the dermal membrane and occurring also in the choanosome, 0·009- 0·012 mm.

Oxyasters 0·025–0·031 mm. ; actines slender, beset with spines so low as to be mere roughenings. These microscleres often have only 6 rays lying in 3 axes at right angles ; in this case one pair of rays is longer than the other two pairs, which are equal to one another.

Pulau Bidang.

17. HYMEDESMIA HALLEZI Topsent.

Hymedesmia hallezi Topsent, Arch. de Zool. Exp. (3) t. viii. p. 119 (1900).

Sponge growing on a lamellibranch shell together with *Samus anonymus*.

Besides the spicules of the vertical bundles which rest with their oval heads in contact with the surface of support, other more slender tylostyles lie horizontally. The microscleres are distributed uniformly. They are asters of which the slender rays are swollen at the tips. There is a distinct centrum somewhat sharply marked off from the rays. They thus differ to a certain extent from those of the type ; but as Topsent mentions that the rays of the spherasters of *H. hallezi* sometimes end in a "*petit bouton non élargi*," this difference is probably unimportant.

Vertical tylostyles 0·6 -0·88 × 0·01 mm.

Horizontal tylostyles 0·50 × 0·002-0·003 and 0·56 × 0·007.

Pulau Bidang.

18. SPIRASTRELLA INCONSTANS Dendy. (Plate XIV. fig. 3.)

Spirastrella inconstans Thiele, Studien über pacifische Spongien, Zoologica, xxiv. ii. p. 10, pls. 1 & 5.

A single specimen with the note: "a grey sponge from between the stones between tide-marks. *Loc.* Pulau Bidang, *R. Evans.*"

The identification has been made on the evidence of spicules alone. If it should be correct, the specimen affords yet another example of the extraordinary variety in outward form of this species. The sponge is a simple tube attached below to a small pebble, with the single osculum at its free end. The surface is even.

The skeleton is formed of stout fibres of tylostyles running obliquely to smaller tylostyles projecting vertically to the surface. In the ectosome spirasters are sparsely distributed: they are not present in the interior of the sponge.

Tylostyles of the main skeleton 0·570 × 0·025 to 0·30 × 0·01 mm.

Tylostyles of the ectosome 0·24 × 0·01 mm.

Spirasters: length 0·02–0·03 mm.; average number of bends 3; number of spines to each bend 3–5.

Pulau Bidang.

19. Suberites laxosuberites, n. sp. (Plate XV. fig. 4.)

Sponge encrusting, 1–4 mm. in thickness. Oscula not visible. Colour in spirit whitish. Surface even, slightly hispid.

The skeleton consists of short ascending and diverging fibres of styles and of small styles in the ectosome projecting at the surface.

Thus this species combines the fibrous arrangement of the styles of the main skeleton—an arrangement characteristic of *Laxosuberites* Topsent (Arch. de Zool. Exp. sér. 3, t. viii. p. 184)—with the possession of an ectosomal skeleton of small styles like that of *Suberites*. Occasional tylostyles are to be found among the styles of the main skeleton.

Styles 0·70 × 0·026 to 1·12 × 0·04 mm., the breadth measured being the greatest breadth.

Styles of the ectosome 0·25 × 0·004 mm.

Tylostyles 0·70 × 0·02; breadth of head 0·01 mm.

Pulau Bidang.

20. Pseudosuberites cava, n. sp. (Plate XIV. fig. 6.)

Sponge encrusting, with a few outlying free lobes; transparent; rusty-brown in spirit.

The subdermal cavities are large, and as the sponge forms only a thin crust, they traverse almost its whole thickness; the sponge thus consists of two lamellæ, one attached to the substratum, the other being the dermal membrane, while columns containing bundles of spicules stretch vertically between them.

The spicules in the dermal membrane lie parallel to the surface, those in the columns on reaching the surface spread out and just extend beyond the dermal membrane.

Spicules: Styles (not tylote as in the other species of the genus), the largest measuring 0·54 × 0·012 mm.

21. Terpios fugax Duchassaing & Michelotti.

Terpios fugax Keller, Zeitschr. f. wiss. Zool. lii. p. 319; Topsent, Arch. de Zool. Exp. (3) viii. p. 193.

Sponge growing on a lamellibranch shell together with *Amorphina* sp. and *Hymedesmia hallezi*.

TETRAXONIA.

CARNOSA.

22. DERCITUS PLICATUS Topsent.

Dercitus plicatus Topsent, Arch. de Zool. Exp. (3) iii. p. 493 (1895).

Sponge growing on a valve of lamellibranch shell. Pinkish. Surface uneven.

Spicules calthrops-like microtriænes and spined microxeas; microdichotriænes absent.

The spicules have a somewhat wider range of size than those of Topsent's specimens.

Orthotriænes, cladus 0·10–0·24 × 0·015–0·027 mm.

Microxeas 0·012 0·025 × 0·002 0·003 mm., including the spines.

Great Redang.

23. DERCITUS PAUPER, n. sp. (Plate XV. fig. 1.)

Sponge pink, encrusting. The specimen is growing on a piece of dead coral skeleton; it forms a long narrow band about 50 × 5 mm. and 1 or 2 mm. thick. Surface smooth and shining. No oscula visible.

The megascleres are small dichotriænes or simple calthrops-like microtriænes (the latter spicule rare). The megascleres are sparsely distributed, contrasting with the interlocking spicules in *D. plicatus*.

Dichotriæne, protocladus 0·05–0·06 × 0·01; deuterocladus 0·03; rhabdome 0·08 mm.

Orthotriæne, cladus 0·06–0·07 × 0·003 mm.

Spined microxeas 0·015–0·02 × 0·001 mm.

Great Redang.

24. SAMUS ANONYMA Gray.

Samus anonyma Gray, P.Z.S. 1867, p. 526; Carter, A. M. N. H. ser. 5, vol. iii. p. 350 (1879); Sollas, Voy. of H.M.S. 'Challenger,' vol. xxv. p. 57.

Sponge growing on a lamellibranch shell in company with *Terpios fugax* and *Hymedesmia hallezi*.

The measurements of the spicules agree with those given in the 'Challenger' Monograph.

Pulau Bidang.

TETRACTINELLIDA.

25. TETILLA RIDLEYI Sollas.

Tetilla ridleyi Sollas, 'Challenger' Monograph, xxv. p. 48.

Sponge hemispherical; surface rough; oscula few, small, with slightly raised rims, forming an interrupted ring round the sponge. Diameter of base about 16 mm.

Oxeas 2·16 × 0·026 mm.

Protriænes, cladus 0·037–0·14 mm.

Anatriænes, cladus 0·015–0·08 mm.

The cladi when as short as 0·015 mm. are also very thick.

Sigmata 0·011 mm.

The skeleton of the walls of the oscular tubes consists of strands of the more slender protriænes and prodiænes, oxeas being absent in these parts.

The ciliated chambers are 0·02 mm. in diameter. In their present state they have very distinct "Sollas' membranes."

Pulau Bidang.

26. CINACHYRA MALACCENSIS, n. sp. (Plate XIV. fig. 2 and Plate XV. fig. 5.)

Since the description of the type species, *C. barbatus* Sollas (Voyage of H.M.S. 'Challenger,' vol. xxv. p. 23, pls. iii. & xxxix.), four new species have been added to the genus; v. Lendenfeld when he states (Abh. Senck. Ges. xxi. p. 107, 1897) that his *C. voeltzkowi* from Zanzibar is the only species found since the type, overlooks the three species described by Keller (Zeit. f. wiss. Zool. lii. p. 336, pl. xix., 1891).

The genus as now known contains the following species:—

A. Pores confined to the porocalyces.
- α. Porocalyces rough with fine hispidating protriænes.
  - *a.* With rooting spicules, with cortical oxeas, with projecting ridges on the surface of the porocalyces .. . . *C. barbata* Soll.
  - *b.* Without the three characters mentioned as occurring in *C. barbata*. With rhabdodragmas scattered throughout the tissues. *C. eurystoma* Keller. Red Sea.
- β. Porocalyces without hispidating spicules. Microxeas throughout the tissues.
  - *a.* Porocalyces with an even surface. Sponge spherical with smooth surface. *C. schulzei* Keller. Coast of Aden and Mozambiqne Channel.
  - *b.* Porocalyces with a network of projecting ridges. Sponge conical. *C. trochiformis* Keller. Red Sea.

B. Pores not confined to the porocalyces, which latter are without hispidating spicules .... *C. voeltzkowi* Lendenfeld. Zanzibar.

The present specimens agree with *C. voeltzkowi* in possessing scattered pores in addition to those of the porocalyces. The surface of the latter structures is raised into a network of fine ridges, but lacks hispidating spicules. The sigmata are smaller than in any hitherto described species.

The sponge approaches a hemispherical form; one specimen having become attached laterally is almost bracket-shaped; in the other the curved surface occupies more than a hemisphere, while the basal membrane is folded and forms a conical surface concave to the exterior.

The porocalyces are either cup-shaped or shell-shaped, in the latter case as much as 3 mm. in diameter.

The cortex is a uniform fibrous collenchyma; canals passing through it from the scattered pores are clearly marked by the abundant sigmata in their walls. The ciliated chambers are small—from 0·015–0·018 mm. in diameter, and composed of only

a few cells, for the most part about 9 cells may be seen on a cross section.

Oxeas $1{\cdot}4 \times 0{\cdot}016$ to $3{\cdot}2 \times 0{\cdot}048$ mm.

Protriænes 2–3 mm. long; cladus 0·03–0·18 mm.

Anatriænes 2·2 mm. long; cladus 0·04–0·08 mm.

Sigmata 0·008–0·009 mm.

Pulau Bidang off the coast of Kedah.

KERATOSA.

27. EUSPONGIA OFFICINALIS ? var. ROTUNDA.

It is fairly evident that a small piece of sponge separately preserved has been cut off from one of two large specimens, though there is no note to that effect. In this more carefully treated piece the ectosome is preserved, while in the whole sponges very little of it remains and the surface consequently has a honeycombed appearance.

Sponge about 50 mm. high, forming a massive circular wall round a small central hollow.

Oscula numerous, 2–6 mm. in diameter.

Conuli 0·88–1·5 mm. apart and about 0·5 mm. high.

Main fibres 0·04–0·08 mm. thick and on an average ·8 mm. apart.

Secondary fibres 0·01–0·03 mm. thick, the most common thickness being 0·02 mm.

Ciliated chambers 0·02–0·03 mm. in diameter.

Aphodal canals 0·015 mm. broad and 0·02–0·03 mm. long.

Colour, in spirit, dark grey externally and pinkish buff within.

Great Redang.

28. STELOSPONGIA sp.

A small sponge growing on a piece of dead coral.

Surface very smooth, with sparse low conuli.

The skeleton is irregular, conspicuously closer-meshed in parts, but it is somewhat difficult to speak of definite fascicles. These smaller meshes measure from 0·3–0·5 mm., while the large ones are about 1·0 mm.

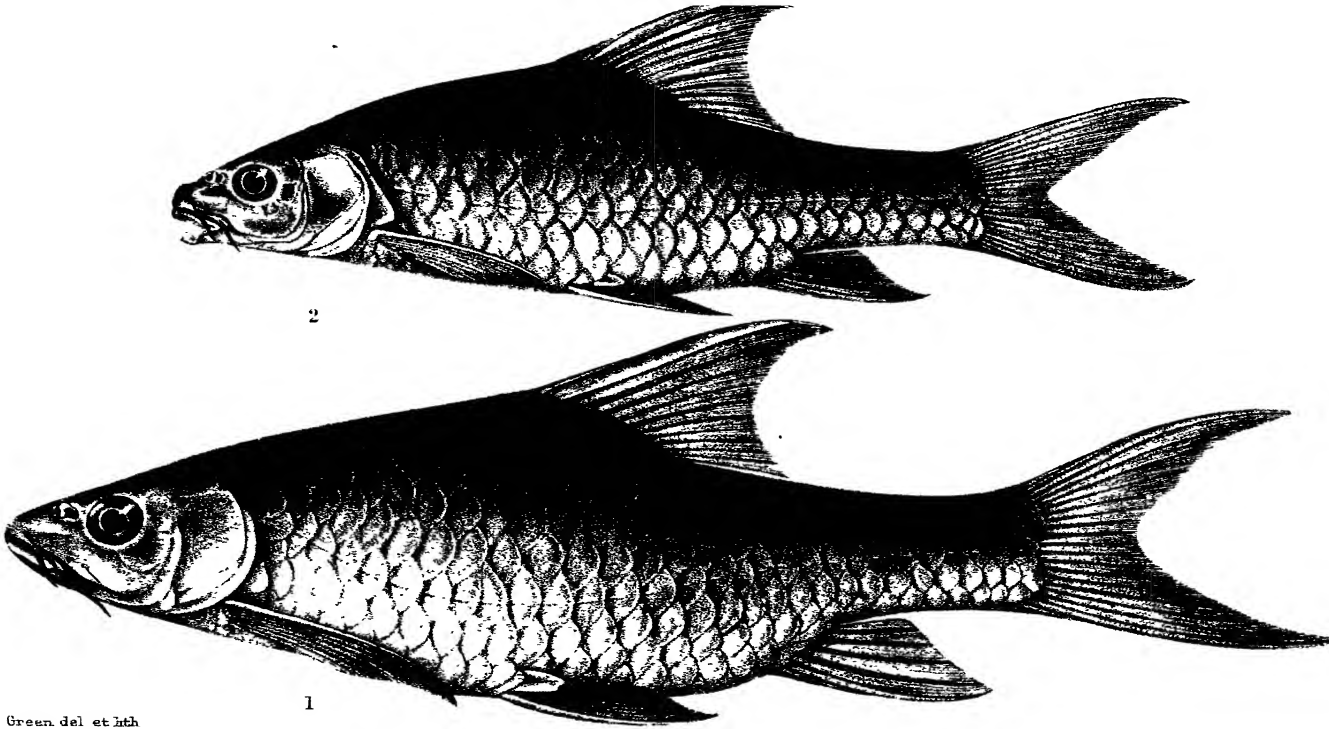
The main fibres measure 0·08–0·12 mm. and have as a rule a dense core of foreign spicules. Occasionally there are large sand-grains at the nodes of the skeleton.

The secondary fibres have a slender axial thread or line of foreign spicules, or sometimes are quite free of spicules.

Great Redang.

29. SPONGELIA DIGITATA, sp. n. (Plate XIV. fig. 4 and Plate XV. fig. 2.)

Sponge attached by a thin encrusting base to a rod-shaped piece of dead coral. From this it rises as a long ridge (50 mm. long) which breaks up distally into flattened, bluntly ending processes, measuring 25×3–10 mm.



2

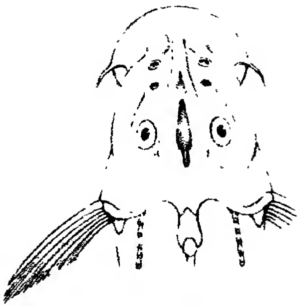
1

Green del et lith

Mintern Bros imp

1 BARBUS HINDII   2 BARBUS PERPLEXICANS

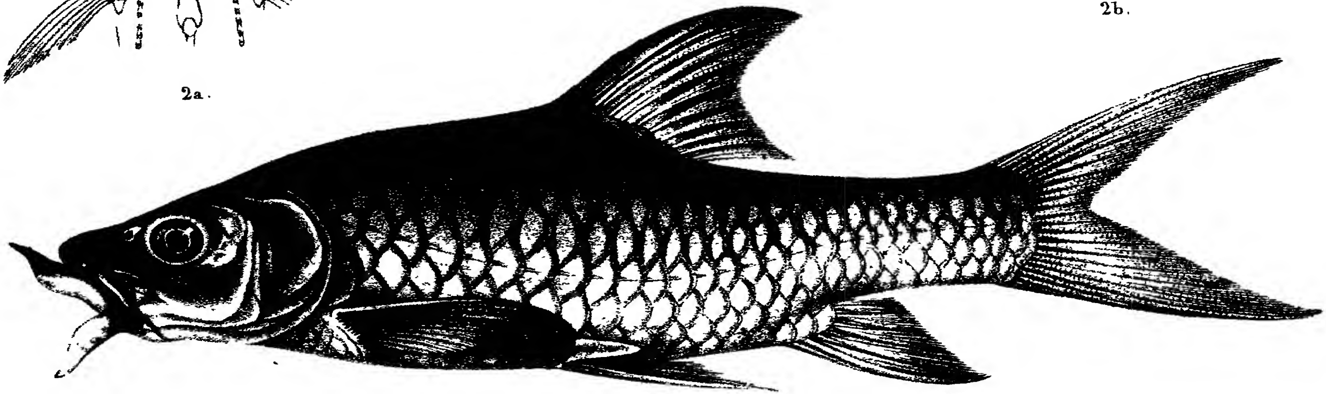
P Z S 1902, vol II Pl XVII



2a.

2.

2b.



1

J. Green del et lith.

1 BARBUS LABIATUS

2 CHILOGLANIS BREVIBARBIS

Mintern Bros imp.

Surface covered with low conuli 1–2 mm. apart and 0·2–0·4 mm. in height.

Oscula (?) minute, inconspicuous near the tips of the lobes.

The skeleton consists of a network of very thin fibres, which are not distinguishable into main and secondary, and are uniformly areniferous. They form for the most part square meshes about 0·64 mm. in breadth.

Fibres 0·03–0·06 mm. thick.

The ectosome is a thin layer of cystenchyma, thickest at the tips of the lobes. Only in this layer are spongoblasts obvious.

Spermatozoa are present in various stages and in great abundance.

The ciliated chambers measure ·07 × ·04 mm. on an average.

The whole choanosome is permeated by a filamentous alga (? *Oscillaria spongeliæ*).

Great Redang.

EXPLANATION OF THE PLATES.

Plate XIV.

Fig. 1. One of the digitiform processes of *Ciocalypta melichlora*, p. 214. Nat. size.
2. *Cinachyra malaccensis* (p. 219), slightly larger than nat. size.
3. *Spirastrella inconstans* (p. 216), attached to a fragment of stone. Nat. size.
4. *Spongelia digitata* (p. 220), attached to a branch of dead coral. Nat. size.
5. *Reniera* sp. 1 (p. 210), growing on a crab. × 2.
6. A section of *Pseudosuberites cava* (p. 217). × 15.
7. *Ciocalypta rutila* (p. 215), almost the entire specimen. × $\frac{3}{2}$.
8. *Esperella sulevoidea* (p. 213), in section. × 20.
9. *E. sulevoidea* (p. 213), entire specimen. × $\frac{3}{2}$.

Plate XV.

Fig. 1. Microcalthrops and spined microxea of *Dercitus pauper*, p. 218.
2. One complete mesh of the skeleton of *Spongelia digitata*, p. 220.
3. *Reniera* sp. 5 (p. 211). *a*, node of the skeletal network; *b*, egg; *c*, ciliated chamber; *d*, isolated spicule; *e*, piece of fibre with chaplet-cells; *f*, isolated chaplet-cell: *f′*, its segment of fibre.
4. Spicules of *Suberites laxosuberites*, p. 217.
5. Megascleres of *Cinachyra malaccensis*, p. 219.
6. Sigmata and centrangulate sigmata of *Gellius centrangulatus*, p. 212.
7. Sigmata, toxa, and centrangulate sigmata of *Gellius sagittarius*, p. 212.
8. Spicules of *Ciocalypta melichlora*, p. 214.
9. Spicules of *Biemma democratica*, p. 213.
10. Spicules of *Esperella sulevoidea*, p. 213.
11. Spicules of *Reniera* sp. 2, p. 210.

8. On the Fishes collected by Mr. S. L. Hinde in the Kenya District, East Africa, with Descriptions of Four new Species. By G. A. Boulenger, F.R.S.

[Received May 30, 1902.]

(Plates XVI. & XVII.[1])

The zoological collection recently made by Mr. S. L. Hinde in British East Africa contains a series of Fishes from the Mathoiya River, in the Kenya district, which usefully supplement our

[1] For explanation of the Plates, see p. 224.

knowledge of the fauna of the Tana system, for the first information on which we are indebted to Dr. J. W. Gregory.[1]

A striking feature in the composition of this fauna is the presence of several species of the Cyprinid genus *Barbus*, agreeing in the large scales and the position and structure of the dorsal fin, the last simple ray of which is very large, osseous, and non-serrated, yet differing strikingly in the buccal characters. Two of these species had been described by Dr. Günther as *Barbus tanensis* and *B. intermedius* (Rüppell); three are here added, and although evidently nearly related they would have to be referred to as many genera, viz.: *Barbus*, *Labeobarbus*, and *Capoëta*. *Labeobarbus* has already been relegated to the synonymy of *Barbus* by Günther[2], and I now feel compelled to do the same with *Capoëta*, with all the more confidence, since new forms recently discovered in Morocco support the same conclusion[3].

CYPRINIDÆ.

1. LABEO FORSKALII Rüpp.

2. LABEO (TYLOGNATHUS) MONTANUS Gthr.

3. BARBUS TANENSIS Gthr.

4. BARBUS HINDII, sp. n. (Plate XVI. fig. 1.)

Depth of body $2\frac{4}{5}$ to $3\frac{1}{3}$ times in total length, length of head 4 to $4\frac{1}{3}$ times. Snout rounded, feebly projecting beyond the mouth, $1\frac{1}{4}$ to $1\frac{1}{2}$ times as long as the eye, the diameter of which is 4 to $4\frac{1}{2}$ times in the length of the head and $1\frac{1}{3}$ to twice in the interocular width; width of the mouth about half that of the head; lips feebly developed; two pairs of barbels, the first as long as the eye or a little longer, the second a little longer than the first but not more than $1\frac{1}{2}$ the diameter of the eye. Dorsal IV 9–10, fourth ray very strong, straight, bony, not serrated, as long as the head or longer; the fin is notched and originates above the first rays of the ventral, at equal distance from the end of the snout and the root of the caudal or a little nearer the former. Anal III 5; longest ray $\frac{3}{4}$ to $\frac{4}{5}$ the length of the head and narrowly separated from the root of the caudal. Pectoral pointed, nearly as long as the head, not reaching the ventral. Caudal deeply forked. Caudal peduncle $1\frac{1}{3}$ to $1\frac{2}{3}$ as long as deep. Scales 25–29 $\frac{4\frac{1}{2}-5\frac{1}{2}}{4\frac{1}{2}}$, 2 between the lateral line and the root of the ventral. Olive-brown above, silvery below; fins greyish.

Total length 240 millim.

Several specimens.

Distinguished from *B. tanensis* by the shorter barbels.

[1] *Cf.* Günther, "Report on the Collection of Reptiles and Fishes made by Dr. J. W. Gregory during his Expedition to Mount Kenya," P. Z. S. 1894, pp. 84–91, pls. viii.–xi.

[2] Cat. Fish. vii. p. 84.

[3] *Cf.* Boulenger, Ann. & Mag. N. H. (7) ix. 1902, p. 124.

5. Barbus (Capoëta) perplexicans, sp. n. (Plate XVI. fig. 2.)

Depth of body 3 times in total length, length of head 4 times. Snout rounded, slightly concave in front of the nostrils, feebly projecting beyond the mouth, $1\frac{1}{2}$ as long as the eye, the diameter of which is 4 times in the length of the head and $1\frac{2}{3}$ in the interocular width; width of mouth about half that of the head; lips feebly developed; lower jaw with a strong, transverse, horny cutting-edge; two pairs of barbels, subequal, and as long as the eye. Dorsal IV 10, fourth ray very strong, straight, bony, not serrated, as long as the head; the fin is notched and originates slightly in advance of the vertical of the first ray of the ventral, a little nearer the end of the snout than the root of the caudal. Anal III 5; longest ray $\frac{1}{3}$ the length of the head and narrowly separated from the root of the caudal. Pectoral pointed, nearly as long as the head, narrowly separated from the ventral. Caudal deeply forked. Caudal peduncle $1\frac{1}{2}$ as long as deep. Scales 26–30 $\frac{4\frac{1}{2}}{4\frac{1}{2}}$, 2 between the lateral line and the root of the ventral. Olive-brown above, silvery below; fins whitish.

Total length 175 millim.

Two specimens.

Although unquestionably referable to the genus *Capoeta* as defined by Günther, this species is so closely related to the preceding that I have felt some hesitation in separating it. However it differs, in addition to having a cutting horny edge on the lower jaw, in the shape of the snout, the shorter posterior barbel, and the origin of the dorsal fin slightly more anterior.

6. Barbus (Labeobarbus) labiatus, sp. n. (Plate XVII. fig. 1.)

Depth of body a little greater than length of head, $3\frac{1}{3}$ times in total length. Snout obtusely pointed, not projecting beyond the mouth, twice as long as the eye, the diameter of which is $5\frac{1}{2}$ times in the length of the head and twice in the interocular width; width of the mouth about half that of the head; lips extremely developed, each produced into a long triangular flap; two pairs of barbels, the first as long as the eye, the second slightly longer. Dorsal IV 9; fourth ray very strong, curved, bony, not serrated, $\frac{3}{4}$ the length of the head; the fin is notched and originates above the first rays of the ventral, at equal distance from the nostrils and the root of the caudal. Anal III 5; longest ray $\frac{2}{3}$ the length of the head and narrowly separated from the root of the caudal. Pectoral pointed, nearly as long as the head, reaching the base of the ventral. Caudal deeply forked. Caudal peduncle $1\frac{1}{2}$ as long as deep. Scales 28–29 $\frac{4\frac{1}{2}-5\frac{1}{2}}{4\frac{1}{2}}$, 2 between the lateral line and the root of the ventral. Dark olive-brown above, whitish beneath; fins grey.

Total length 270 millim.

A single specimen.

The larger scales and the longer pectoral fin distinguish this fish from the one referred by Günther to *B. intermedius* of Rüppell,

and which has 8 or 9 branched rays to the dorsal fin and three series of scales between the lateral line and the ventral fin.

The *Barbus* described by Rüppell from Lake Tsana, under the names of *Barbus intermedius*, *B. affinis*, *B. elongatus*, and *Labeobarbus nedgia*, the type-specimens of which have been kindly entrusted to me by the Directors of the Senckenberg Museum, agree with the Tana species in the large scales and the very strong fourth dorsal ray. All have 8 branched rays in the dorsal fin and 3 series of scales between the lateral line and the ventral fin.

Siluridæ.

7. Chiloglanis brevibarbis, sp. n. (Plate XVII. fig. 2.)

Body slightly depressed, its depth 6 times in total length. Head strongly depressed, $1\frac{1}{3}$ as long as broad, its length 3 times in total length. Eye directed upwards, in the second half of the head, its diameter $5\frac{1}{2}$ times in length of head and $1\frac{1}{3}$ in interorbital width; anterior nostril equally distinct from the end of the snout and the eye, posterior separated from the eye by a space equal to the diameter of the latter; præmaxillary teeth wide apart, in two large oval groups, forming 4 or 5 transverse series; 6 rather strong mandibular teeth; maxillary barbel scarcely longer than the eye, lower labials shorter than the eye. Dorsal I 5; spine not serrated, half the length of the head. Adipose fin half as long as its distance from the rayed dorsal. Anal III 7. Pectoral spine $\frac{2}{3}$ the length of the head. Ventral extending to the origin of the anal. Caudal forked. Caudal peduncle nearly twice as long as deep. Pale brownish above, with four irregular dark cross-bands connected by a dark lateral stripe, whitish beneath; two dark bars across the anal; a dark bar at the base of the caudal, another across each lobe of the fin, and a dark streak along the lower lobe.

Total length 55 millim.

A single specimen.

This species differs from *C. deckeni* Ptrs. and *C. niloticus* Blgr. in the shorter barbels and the stronger mandibular teeth.

Anguillidæ.

8. Anguilla bengalensis Gray.

Anguilla labiata Ptrs. is not separable from this species.

EXPLANATION OF THE PLATES.

Plate XVI.

Fig. 1. *Barbus hindii*, p. 222, reduced $\frac{2}{3}$.
2. „ *perplexicans*, p. 223, reduced $\frac{2}{3}$.

Plate XVII.

Fig. 1. *Barbus labiatus*, p. 223, reduced $\frac{2}{3}$.
2. *Chiloglanis brevibarbis*, p. 224, nat. size.
2 *a*. „ „ upper view of head, × 2.
2 *b*. „ „ mouth, × 3.

November 4, 1902.

G. A. Boulenger, Esq., F.R.S., Vice-President, in the Chair.

The Secretary read the following reports on the additions made to the Society's Menagerie during the months of June, July, August, and September, 1902:—

The number of registered additions to the Society's Menagerie during the month of June was 286, of which 44 were by presentation, 13 by birth, 10 by purchase, and 217 were received on deposit and 2 in exchange. The number of departures during the same period, by death and removals, was 156.

Amongst these special attention may be drawn to:—

1. A young male Brindled Gnu (*Connochætes taurinus*), born in the Gardens on June 10th, being the second specimen of this Antelope bred by the Society (see P. Z. S. 1900, p. 771, pl. xlviii.).

2. A Sepoy Finch (*Hæmatospiza sipahi*) from India, received in exchange June 10th, being of a species new to the Society's Collection.

3. A male Great Bird of Paradise (*Paradisea apoda*), received in exchange from the Zoological Gardens, Calcutta, on June 15th. This bird, lodged at present in the Insect-house, is doing well, and having moulted, is now acquiring its fresh dress.

4. A young male Proboscis Monkey (*Nasalis larvatus*), obtained by purchase on June 30th, being the first specimen of this remarkable Monkey ever received alive by the Society. A water-colour drawing of it, prepared by Mr. J. Smit (Pl. XVIII.), is exhibited. The animal unfortunately died quite suddenly on September 6th.

The number of registered additions to the Society's Menagerie during the month of July was 292, of which 68 were acquired by presentation, 19 by birth, 18 by purchase, and 187 were received on deposit. The number of departures during the same period, by death and removals, was 207.

Among these special attention may be drawn to:—

1. A young female of the Racket-tailed Parrot of Celebes (*Prioniturus platurus*), purchased July 4th, new to the Collection.

2. A pair of young Giraffes (*Giraffa camelopardalis*), from Kordofan, presented by Col. B. Mahon, C.B., D.S.O., as already announced to the Society (see P. Z. S. 1901, vol. ii. p. 471), which had arrived on July 19th in excellent condition.

3. Two female Grévy's Zebras (*Equus grevyi*), from Southern Abyssinia. These animals were presented to H.M. The King by the Emperor Menelek, and were placed under the Society's care by His Majesty's orders on July 12th.

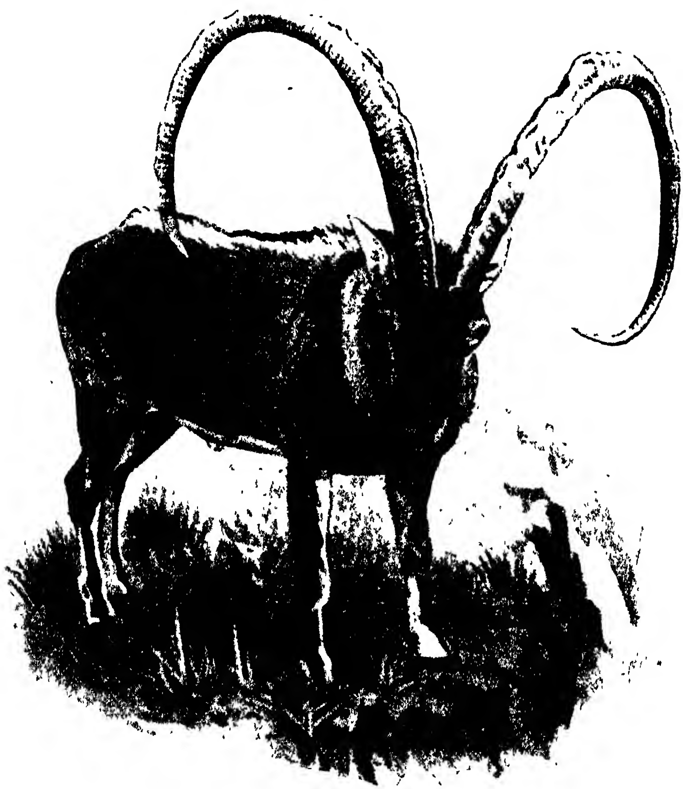
4. A fine young hybrid, believed to have been bred between a stallion Pony and a female Burchell's Zebra (*Equus burchelli*) in the Transvaal Colony, presented by His Majesty The King on July 19th.

The registered additions to the Society's Menagerie during the month of August were 141 in number. Of these 62 were acquired by presentation, 2 by purchase, 8 were born in the Gardens, and 64 were received on deposit and 5 in exchange. The number of departures during the same period, by death and removals, was 160.

The number of registered additions to the Society's Menagerie during the month of September was 125, of which 67 were by presentation, 1 by purchase, 6 were born in the Gardens, and 51 were received on deposit. The number of departures during the same period, by death and removals, was 138.

Mr. Sclater exhibited a photograph of a Persian Ibex (text-fig. 55), obtained in the hills not far from Shiraz (and probably

Text-fig. 55.



Persian Ibex. (Taken from a photograph.)

referable to *Capra ægagrus*), which had been sent to him by Mr. B. T. Ffinch. It was said to have been taken on board the s.s. 'Scharlachberger' in Karachee Harbour, and was the individual referred to by Mr. J. Strip in his letter to 'The Field' of Aug. 6th, 1898 (vol. xcii. p. 274). The length of the left horn was said to be no less than 55½ inches, and the right, which was slightly broken, 50½ inches.

Mr. Sclater exhibited some photographs of the Rocky Mountain Goats in the Gardens of the Zoological Society of Philadelphia, and read the following extracts from Mr. A. E. Brown's letter concerning them:—

"When I saw you in April, you expressed a desire to have a photograph of our Rocky Mountain Goat (*Haplocerus montanus*). I now send you one, taken a few days ago by Mr. Carson of this Society.

"The male was born about May 15th, 1901, in the Canadian Rocky Mountains, near Field, British Columbia, on the Canadian Pacific Railway. The mother was killed on May 29th by a Swiss guide, who captured the kid, raised it by hand, and brought it to the Gardens October 1st. At that time it was 2 feet in height at the shoulder, and weighed 55 lbs. Its horns were 1½ inches long on the anterior face. It now weighs 96 lbs., height 30 inches, length of horns 6¼ inches, circumference at base 4 inches.

"The female was presented to the Society on Dec. 22, 1901. It came from Central Idaho and was evidently bred in the previous year, but I was not able to secure any exact information about it. It is now 28 inches in height; weight 74 pounds; length of horns 7¾ inches, which are more slender than in the male. Both these animals have remained in uniformly good health, but have not yet had to encounter a long period of great heat, the effects of which I fear; but on Saturday last the thermometer rose to 93 Fahr., from which they did not seem to suffer distress."

Dr. Günther exhibited living tadpoles of the North-American Bull-frog (*Rana mugiens*) bred in Surrey. They were the offspring of specimens introduced by the Hon. Charles Ellis, F.Z.S. Although a great number of these tadpoles had been reared this year in the ponds near Mr. Ellis's residence, the majority attaining to their full size, none of them had been observed to complete their metamorphosis. They were therefore obliged to hibernate, like many of the tadpoles of *Rana esculenta* var. *ridibunda*, which have been acclimatized in the same locality.

Sir Henry H. Howorth, K.C.I.E., F.R.S., exhibited and made remarks upon the head of a Virginian Deer (*Cariacus virginianus*) shot by an experienced old hunter in the mountains of New

Mexico. It was interesting from the fact that its horns instead of having grown naturally had become crumpled into a mass of spongy matter still covered with the velvet, and exhibited the morbid growths into which the horns of deer often develop when the animal's genitals are injured. In such cases, not only does the deer cease to shed its horns annually, but they often cease to bear horns at all. Sir Henry suggested that some experiments might be made to try and discover a little more closely the physiological cause of the aborted horns; this might perhaps throw some light on the apparently anomalous fact that in the various races of Reindeer both sexes have horns.

Mr. R. E. Holding exhibited and made remarks upon the lower jaw of a Highland Ram in which the last molar tooth was reduplicated on both sides, and called attention to a curious outward deflection of the coronoid process and its projection beyond the condyle, and the consequent alteration of the sigmoid curve and adjacent parts, the last molar being also pushed out of its normal position by the persistent growth of the reduplicated tooth. Mr. Holding was under the impression that these variations in the form of the jaw were attributable to alterations in its movement to accommodate the supplementary molars.

The following extract from a letter addressed to the Secretary by the Rev. Francis C. R. Jourdain, of Clifton Vicarage, Ashbourne, Derbyshire, was read:—

"In the P. Z. S. for 1901 (vol. ii. p. 216) there appeared an article by Mr. J. G. Millais, F.Z.S., on the (supposed) second occurrence of Bechstein's Bat in England.

"This, of course, was an error, as two specimens of this Bat were taken by my friend Mr. E. W. H. Blagg, of Cheadle, Staffordshire, in the New Forest in 1886, and identified at the British Museum (*see* 'Zoologist,' 1888, p. 260). How Mr. Lydekker came to overlook this in writing his 'Handbook of British Mammals' I cannot understand, as Mr. Blagg's specimens passed through the hands of Mr. Oldfield Thomas. I wrote at the time to Mr. Millais, who expressed his intention of making the correction. As he has not done so, I beg to be allowed to point it out."

Dr. C. W. Andrews, F.Z.S., exhibited specimens and lantern-slides illustrating a collection of fossil vertebrates obtained from the Fayum district of Upper Egypt during the last winter.

The most interesting of the new forms here brought to light was *Arsinoitherium zitteli*, an extraordinary Ungulate discovered by Mr. H. J. L. Beadnell last year. This animal was chiefly remarkable for the enormous bifid bony horn borne on the nasal region; there was also a pair of small conical horns over the

orbits. The teeth were of a very remarkable type; each of the molars consisting of two transverse ridges united internally with the continuous inner wall of the tooth, so that the molar as a whole somewhat resembled a reversed molar of a Rhinoceros The dental formula seemed to have been I. 1, Pm. 3, M. 3, in both upper and lower jaws. The affinities of this animal were quite uncertain, but the limb-bones which seemed to belong to it indicated relationship with the Proboscidea, of which it may have been an early but highly specialized offshoot.

Another peculiar mammal was *Phiomia serridens*, of which the anterior part of the mandible was the type. In this animal there was a single pair of very large procumbent incisors with a peculiarly serrated outer edge; behind this there was a long edentulous diastema, much as in the Rodents, then came a small premolar and a large molar similar to the carnassial of some of the Carnivora. The relationships of this creature were likewise quite uncertain: it had been suggested that it might be a peculiarly modified Creodont, but it possessed some characters that seemed to point to the Diprotodont Marsupials, and even to the Multituberculata. Further material would be necessary before the question could be settled. An early member of the Hyracoidea and a gigantic land-tortoise allied to *Testudo perpiniana*, also found by Mr. Beadnell, were likewise referred to.

The further remains of *Mœritherium* and *Palæomastodon* collected fully confirmed the position ascribed to these genera as early forms of the Proboscidea. Of *Palæomastodon* the upper and lower dentitions were now fully known, with the exception of the front teeth of the upper jaw. The dental formula for the cheek-teeth was: – Pm. $\frac{3}{2}$, M. $\frac{3}{3}$. The single lower pair of incisors were procumbent and in contact in the middle line; anteriorly they wore to a sharp edge. The upper incisors seemed to have been compressed, downwardly-directed tusks, with enamel on one face only. In the skull the jugal bone was large and extended on to the face, not being merely a small bar of bone in the middle of the zygomatic arch as in the Elephantidæ.

Dr. Andrews pointed out the great differences between the Middle Eocene *Mœritherium* and the Upper Eocene *Palæomastodon*, and suggested that the more rapid rate at which evolution seemed to have proceeded in the earlier stages of development of many groups of mammals might perhaps in some cases be accounted for as follows:—

"Among the Ungulates, at least, the earlier members of a group "are usually of small size, and as specialization advances an "increase in bulk also takes place; a well-marked instance of this "may be seen in the line of descent of the Horse, and there are "many other cases. This increase in bulk must, in most cases, "involve a lengthening of the individual life, which is often 'indicated in the gradually increasing hypselodonty of the teeth, "implying an increased period of efficiency. When the length

"of the individual life becomes greater, a proportionately smaller "number of generations will succeed one another in a given time, "and therefore the rate of change that the stock will undergo will "be lowered. The same cause may have brought about the ex-"tinction of many of the bulky, highly specialized, and presumably "slow-breeding groups of animals, such as the Titanotheres, which "have been unable to undergo sufficiently rapid modification "to enable them to keep in harmony with a changing en-"vironment."

The following papers were read:—

1. Observations on some Mimetic Insects and Spiders from Borneo and Singapore. By R. Shelford, M.A., C.M.Z.S., Curator of the Sarawak Museum. With Appendices containing Descriptions of new Species by R. Shelford, Dr. Karl Jordan, C. J. Gahan, the Rev. H. S. Gorham, and Dr. A. Senna.

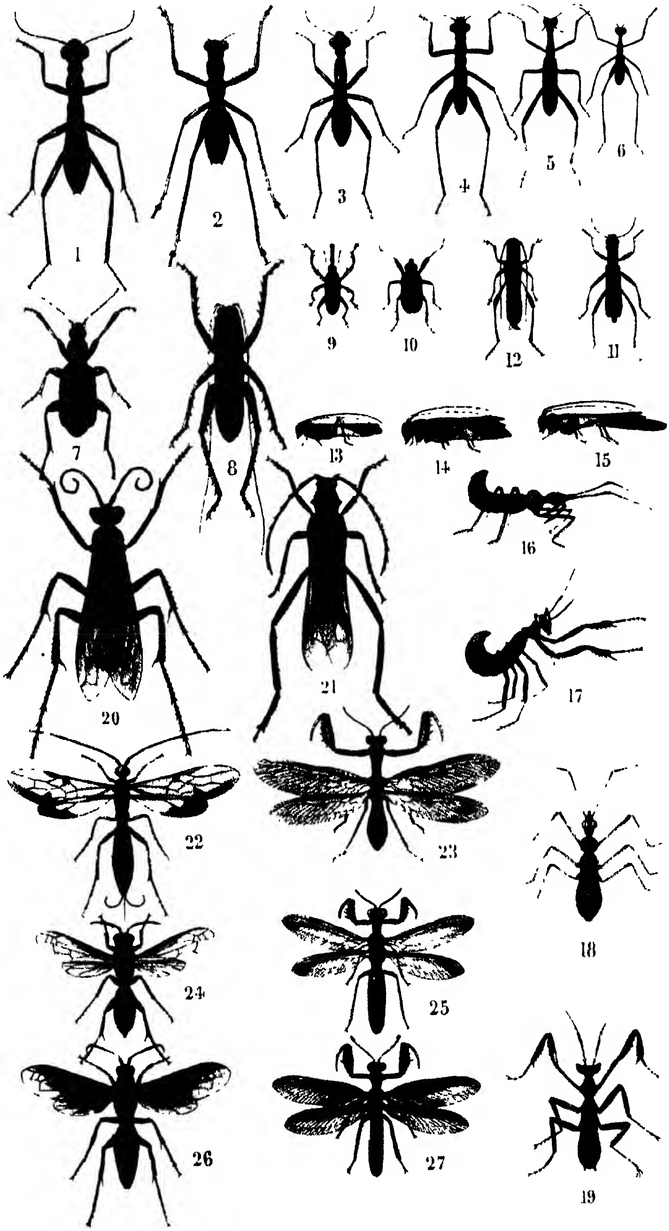
[Received November 13, 1901.]

(Plates XIX.-XXIII.[1])

The theory of mimicry having originated and having been further elaborated chiefly from a study of South American insects, it is but natural that these should figure largely in all works relating to the subject. This paper, a brief abstract of which, arranged by Professor Poulton, appeared in the British Association Reports, 1900, p. 795, is an attempt to bring into greater notice the richness of the Malayan sub-region in similar mimetic species—nearly all the examples here described and discussed having been captured within the last four years in a circumscribed area of 10 mile radius, with Kuching, the capital of Sarawak, as its centre. A recent collecting-trip of three weeks' duration to Mt. Penrissen (about 50 miles inland) was productive of several new examples; and I feel convinced that a similar reward awaits the collector on other mountains of the island and on those of Sumatra, Celebes, and other numerous islands of the great Archipelago, many of which are still virgin ground to the entomologist.

In order to summarize as much as possible our knowledge of the mimetic insects of Borneo, I have drawn up tables of the mimetic Longicorn Beetles and of the Lepidoptera; the latter is a modification of a somewhat similar list given by Haase in his 'Researches on Mimicry' (English translation), Stuttgart, 1896, but I have found it necessary to question certain conclusions and to make a few additions.

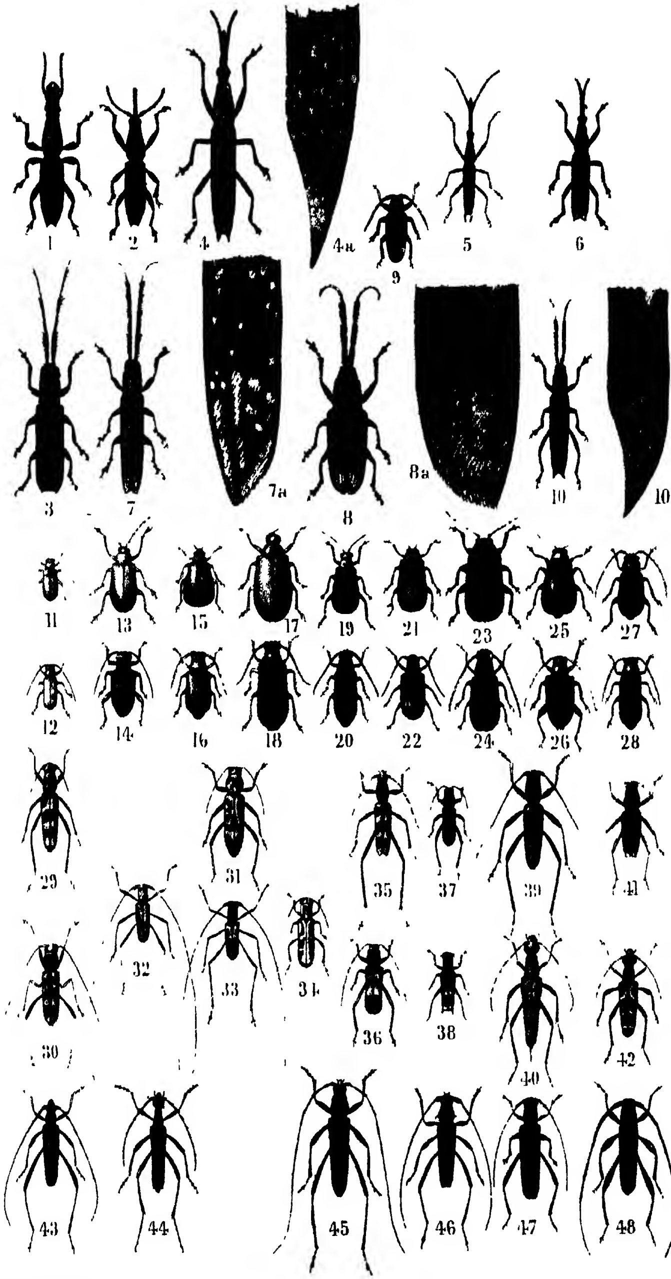
[1] For explanation of the Plates, see page 281.



Horace Knight del et lith.

Mintern Bros Chromo

MIMETIC BORNEAN INSECTS AND THEIR MODELS



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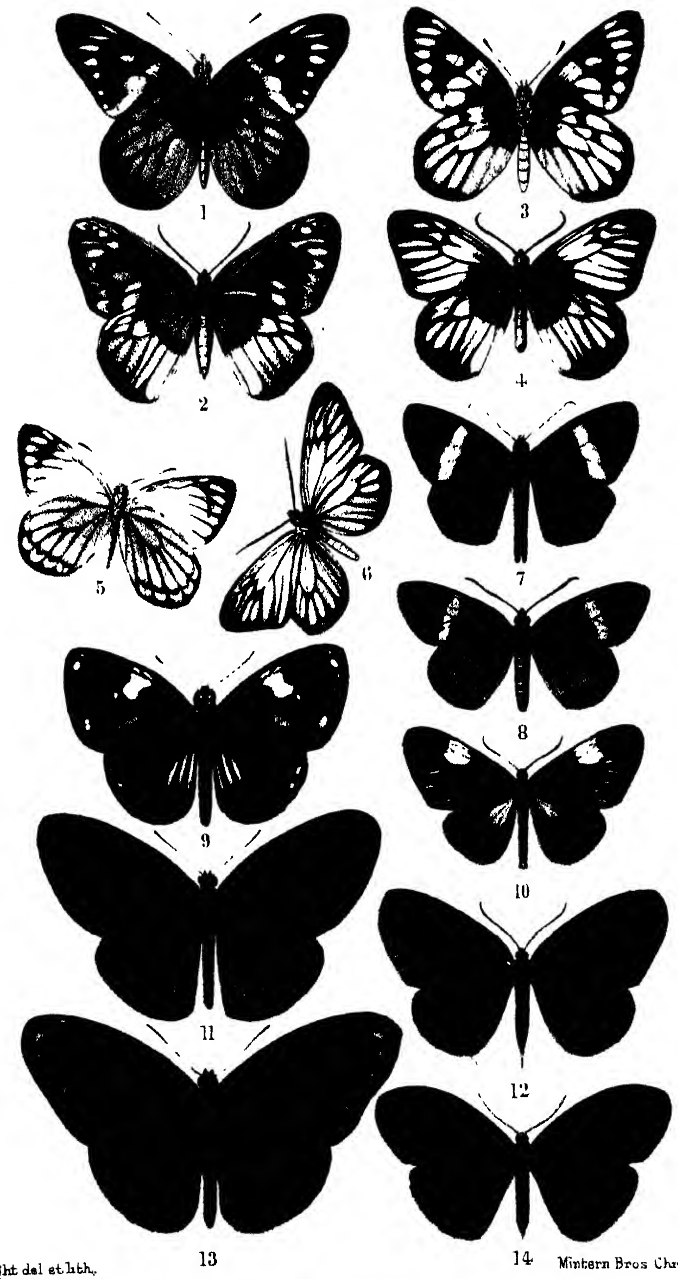
MIMETIC BORNEAN COLEOPTERA AND THEIR MODELS



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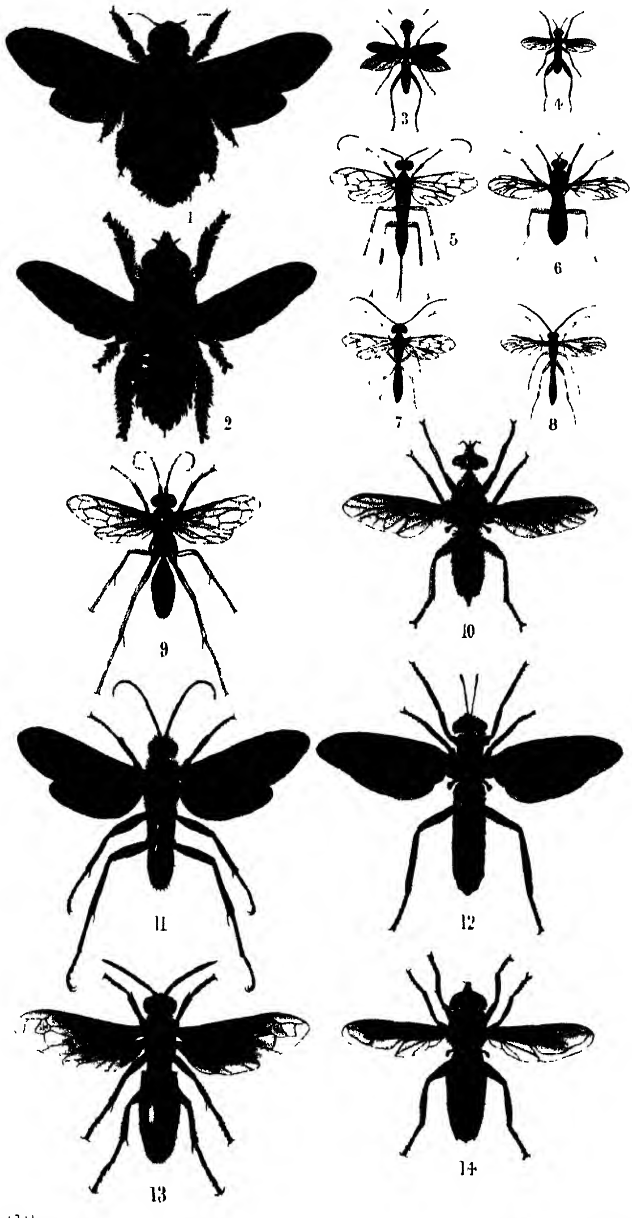
MIMETIC BORNEAN CHALCOSID MOTHS AND THEIR MODELS.



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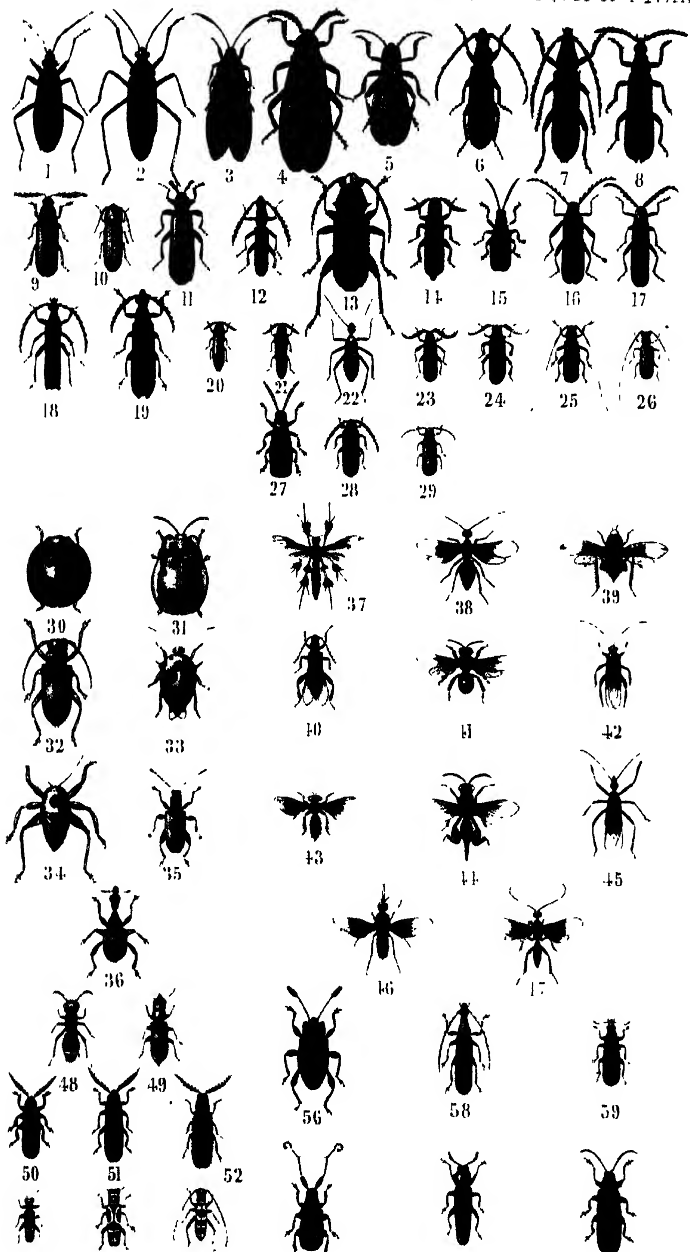
MIMETIC BORNEAN DIPTERA AND THEIR MODELS



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MÜLLERIAN MIMICRY IN GROUPS OF BORNEAN INSECTS

It is frequently possible to pair a mimicking species with a definite specific model, but perhaps more frequently the mimic (either a Batesian or a Müllerian mimic) in its general appearance resembles a whole group of known distasteful insects; or, in other words, the general appearance of the mimic is typical of a distasteful group, rather than exactly similar to one definite species; and in these tables of mimetic Longicorns and their models I have by no means included all, but merely typical models.

The diagrammatic tables of convergent groups of pseudaposematic and synaposematic insects at the end of the paper include, however, all the known distasteful insects which serve as models in the respective groups.

In the Appendices are described a new species of Butterfly, a new Moth, two new genera and several species of Longicorn Beetles, two new Clerids, and two new Brenthids. I owe the description of all except the first-mentioned species to the kindness of Dr. Karl Jordan, Mr. C. J. Gahan, the Rev. H. S. Gorham, and Dr. A. Senna.

Professor E. B. Poulton, F.R.S., has added some interesting and suggestive remarks on my observations: these are scattered throughout the paper, but in all cases his initials are affixed.

My task, in the absence of a large library and of named collections for comparison and reference, has not been easy, but I have received the most valuable and generous aid from Professor Poulton, whom I feel that I can never sufficiently thank. It is not too much to say that had it not been for his help this paper could not have been written. Most of the specimens here described and figured are now deposited in the Hope Museum, Oxford, where they can be seen by all students of the subject. I am much indebted to Mr. H. N. Ridley, Director of the Botanic Gardens, Singapore, for directing my attention to some interesting cases of mimicry observed by him and for some valuable notes thereon. Mr. Gilbert J. Arrow, Monsieur Jules Bourgeois, Mr. Malcolm Burr, Sir G. Hampson, Dr. F. A. Dixey, Dr. R. Gestro, the Rev. O. Pickard-Cambridge, F.R.S., Mr. R. McLachlan, F.R.S., Mr. W. L. Distant, Mr. C. J. Gahan, Dr. Senna, Mr. M. Jacoby, Col. Bingham, Mr. E. E. Austen, Mr. C. O. Waterhouse, Dr. Brunner von Wattenwyl, and Col. Yerbury have rendered much kind assistance in identifying many of the species noted in this paper, and to these gentlemen I tender my grateful thanks.

I. ORTHOPTERA AS MIMICS.

i. **Mimic.** Larva of *Hymenopus bicornis* (Stoll).
Plate XIX. figs. 17 & 19. × 2.

Model. Larva of *Eulyes amœna* (Fab.).
Plate XIX. figs. 16 & 18. × 2.

The newly-hatched larvæ of *Hymenopus bicornis*, one of the

Harpagid Mantidæ, mimic the young larvæ of the Reduviid bug, *Eulyes amœna*, not only in coloration, but also in the peculiar habit of walking about with the abdomen curled over the back (compare figs. 16 & 17). When the young Mantides first emerge from the ootheca they are of a brilliant red colour, the head, basal joint of the antennæ, apices of the femora, and the tibiæ alone being jet-black. A similar arrangement of colours is exhibited by the young of *E. amœna*: in these the head, apices of the femora, bases of the tibiæ, the wing-rudiments, and some spots on the dorsal surface of the abdomen are black, whilst all the rest is vermilion (compare figs. 18 & 19). The newly-hatched larvæ of the bug are very much smaller than the corresponding stage of the Mantis, but after the second moult the size of the former is almost the same as that of their mimics when newly-hatched. The brilliant coloration of the bug is essentially a warning signal, being correlated with an objectionable smell and presumably a still more objectionable taste, judging from the expressions of disgust manifested by two tame monkeys (*Macacus cynomolgus*) after tasting the specimens I offered them. The young *Hymenopus* they had eaten with the utmost sangfroid a few days before, from which one may justly conclude that in this case the coloration is deceptively warning or pseudaposematic (truly mimetic). It is unfortunate that I was unable to rear, or even to keep alive for a few days longer, the young Mantides; but they are notoriously difficult insects to rear, and all my specimens died before I was able to obtain the young of *Eulyes amœna*. The pupa and adult of this species of Mantis are floral simulators: the former resembles a pink Melastoma; the latter, which is cream-coloured varied with brown, resembles the flower of an orchid of fairly common occurrence; and I have also seen a young larva which bore a striking resemblance to a small pink flower of an order not known to me. I have had this insect in various stages of its life-history frequently under observation, and can confirm in almost every detail Mr. Annandale's recently published account of the habits of the pupa (*cf.* P. Z. S. 1900, pp. 839 *et seq.*). That the insect should mimic in the youngest stage of its life-history a distasteful and conspicuously-coloured bug is a fact of some interest.

[The late Mr. L. de Nicéville states, in a letter to Prof. Poulton, that he had reared some species of Mantidæ; one species when newly hatched was remarkably like a small black ant, the deceptive resemblance being so close that a careful scrutiny was necessary to determine the exact nature of the insect. Mr. de Nicéville also remarks:—" A Mantis of fair size does not often move but waits for its prey to come to it, but these young ones ran about incessantly looking for their prey, just like the ants they mimicked."]

ii. **Mimic.** *Condylodera tricondyloides* (Westw.).
Plate XIX. figs. 2, 4, & 6.

Models. *Cicindelidæ.* Plate XIX. figs. 1, 3, & 5.

I was fortunate enough to discover in Sarawak the remarkable Locustid, *Condylodera tricondyloides*, originally described in 1837 by Westwood from Java (Trans. Linn. Soc. vol. xviii. p. 409); the type specimen was at first placed by Westwood in his collection of Cicindelidæ, "regarding it as an immature *Colliurus* or *Tricondyla*" (l. c. p. 419). Another Javan specimen was actually given the MS. name of *Tricondyla rufipes* by Duponchel, so close is the resemblance of this highly deceptive Locustid to a Tiger-beetle. Both these historical specimens are now in the Hope Collection at Oxford, and have been compared with the Sarawak specimens by Mr. Malcolm Burr.

My first specimen, which is somewhat larger than the type, was found in jungle in the neighbourhood of Kuching, running about on the ground amongst dead leaves and other vegetable débris, an environment much frequented by a large Tiger-beetle, *Tricondyla cyanea* (Dej.) var. *wallacei* (Thoms.), with which this Locustid is almost identical in appearance (compare Plate XIX. figs. 1 & 2). The shape, size, coloration, and even the gait of the mimic so closely resembled the corresponding traits of its model, that I did not suspect the importance of my find till a careful examination of the collecting box had been made some hours after the time of capture. The colour of the head, thorax, and abdomen of the *Condylodera* is a dark shining blue, the femora of all the legs are red, the hind femora (which are only slightly swollen) having in addition a proximal black band. The head with its large prominent eyes, somewhat flattened face, and conspicuous jaws, is very Cicindelid in appearance. The antennæ are of extreme tenuity and are about $2\frac{1}{2}$ to 3 times as long as the body. The densely-punctured prothorax is globosely swollen about its middle, the swelling being marked off from the elevated anterior border and posterior portion by broad constrictions. The tegminal and wing rudiments lie very closely adpressed to the body and do not disturb the even contour of the dorsal aspect. The abdomen, though hardly so bottle-shaped as are the elytra and abdomen of the model, is not widely different in appearance, and the intersegmental membranes are quite concealed except on the ventral surface, where the scuta are small, as is usual in this group of insects.

The model is so common and so well known a species that it is unnecessary to describe its general appearance; the above brief description of its mimic will suffice to show in how many superficial points the two insects agree, and superficiality of resemblance is the key-note of mimicry.

Another specimen of this mimetic Locustid of the same size was obtained a few months later in the same locality; and both these

are pronounced to be fully adult by that well-known authority on the Orthoptera, Mr. Malcolm Burr.

Bearing in mind the errors made by Westwood and Duponchel with regard to this insect, I made a careful search through the Sarawak Museum collection of Cicindelidæ, and was rewarded by finding yet another example of this remarkable mimic placed amongst specimens of *Tricondyla gibba* (Chaud.), which it most closely resembles as regards size, coloration, &c. The specimen was smaller than those described above and is evidently a younger stage, but it differs in hardly any other way; and *T. gibba*, the model, also differs from *T. cyanea* var. *wallacei* principally in size (compare Plate XIX. figs. 3 & 4).

A fourth specimen, of a very early stage, was taken in Kuching on the flowers of a flowering tree, frequented also by numerous insects of all orders, amongst others being the Cicindelid, *Collyris sarawakensis* (Thoms.), which serves as a model to the young *Condylodera* (Plate XIX. figs. 5 & 6). At this stage, the insect is entirely dark blue, except the legs which are dark brown, and the greater part of the long antennæ which are ochreous, the four basal joints only being blue. The prothorax shows no trace of the conspicuous puncturation of the adult, nor is it swollen as in the later stages, but more or less cylindrical like that of its model; the wing-rudiments are not yet visible, and the auditory organ on the fore-tibiæ can only be distinguished with difficulty. The model is somewhat larger, of a uniform dark blue with the legs dark brown. It is somewhat curious that the young *Condylodera* does not mimic *Collyris emarginata* (Macl.), a smaller species with red legs, especially since in the later stages it is red-legged species of Cicindelidæ that are mimicked; *C. emarginata* is, however, of a much more brilliant blue than any other Bornean members of the genus, or than the species of *Tricondyla*. This case of mimicry appears to me to be of exceptional interest and without a parallel. I have shown that *Hymenopus bicornis*, a floral simulator throughout the greater part of its life, mimics in its young stages the larvæ of a bug; but I know of no ametabolous insect, except *Condylodera tricondyloides*, which mimics different species of one family during the successive periods of its growth.

iii. **Mimic.** *Gryllacris* n. sp. vicinissima *nigratæ* (Br.). Plate XIX. fig. 8.

Model. *Pheropsophus agnatus* (Chaud.). Plate XIX. fig. 7.

The model in this instance is one of the "Bombardier Beetles," and discharges, when seized or irritated, a jet of formic acid vapour quite powerful enough to scorch the skin of the finger severely and to leave an indelible brown stain on paper or cloth. The insect is quite conspicuous, being black with orange spots on the dorsal surface of the thorax and tegmina; the legs and antennæ are entirely orange. The Locustid is somewhat larger,

and though the markings do not correspond accurately with those of the model, a general resemblance is produced. The head is orange, the prothorax is black with large orange blotches, the tegmina are black with an orange spot at the base of each, corresponding to a similar spot at the base of each elytron of the beetle, and with an orange fascia about the middle, corresponding to a broad orange spot in a similar position on each elytron of the beetle. The legs are banded with orange and black (compare Plate XIX. figs. 7 & 8). The mimic is met with amongst herbage in jungle, and all the examples of the somewhat common "Bombardier" that I have met with were taken in the same environment. The powerful jaws of the larger Gryllacrides furnish possibly an efficient protection against the attacks of vertebrate enemies, such as small birds, lizards, and frogs, but in so small a species as this the resemblance to a beetle capable of discharging a scorching jet of formic acid vapour must be a far more efficient means of protection.

iv. **Mimic.** Nov. gen., nov. sp. vicinissima *Gammarotettigi*. Plate XXIII. fig. 34.

Model. *Coccinellidæ*. Plate XXIII. fig. 30.

In February 1901 the Museum collectors brought in a small Locustid of a brilliant vermilion colour spotted with black. When the insect was resting the head was bent downwards and almost concealed by the large prothoracic shield, the abdomen was strongly curved downwards and the legs were drawn close up to the body, the long hind tibiæ being bent up under their femora: in this attitude the resemblance of the insect to a black-spotted red "ladybird" of a convex shape, e. g. *Caria dilatata* (Fab.), was most striking (compare Plate XXIII. figs. 30 & 34). The eyes are intense black; the large prothoracic shield has three black spots, one central, the others lateral; the segments of the abdomen bear each a small dorsal black spot, decreasing in size posteriorly; the fore- and mid-femora bear outwardly one conspicuous spot, whilst the hind-femora have two such spots.

When touched, this little Locustid did not leap away, as might have been expected, but kept perfectly still, and if further irritated it simply rolled off the surface on which it was resting and assumed a death-like attitude on the ground below, thus simulating very perfectly the habits of a Coccinellid.

I have to thank the distinguished orthopterist Brunner v. Wattenwyl for reporting on this Locustid and the Gryllacris.

II. NEUROPTERA AS MIMICS.

i. **Mimic.** *Mantispa simulatrix* (McLachl.). Plate XIX. fig. 23.

Model. *Bracon* sp. Plate XIX. fig. 22.

This case offers an instance of the distastefulness of the Hymenoptera Parasitica, a group mimicked also by insects

belonging to the most diverse orders, such as Hemiptera, Diptera, Lepidoptera, and Coleoptera.

The model is one of those reddish-ochraceous Braconids, of which there are many representatives in Borneo, all being more or less common. This particular species, with a conspicuous black stigma on the fore wing, is eminently a mountain form, as the numerous specimens in the Sarawak Museum bear witness. Mt. Matang at any elevation above 1500 feet is its favourite haunt, but I have never taken it below that altitude. The mimic, which was recently described[1] by Mr. McLachlan, was captured in the month of August also on Mt. Matang, at an altitude of 2500–2800 feet. It, too, is reddish-ochraceous, whilst each wing bears a black stigma, those on the fore-wings being slightly more conspicuous than those on the hind-wings; the sides and ventral surface of the abdomen are pure white (in the fresh condition), so that when the insect is seen in profile its somewhat bulky body appears to be reduced approximately to the size of the body of its model; as, further, the model also has the ventral surface of the abdomen coloured white, the resemblance between the two insects is still greater (compare Plate XIX. figs. 22 & 23). This method of producing a thin-bodied or wasp-waisted effect by white patches is by no means uncommon amongst insects; I shall be able to give further examples of it in this paper (*vide infra*, pp. 238, 241), and at present need only refer to the well-known Soudanese Locustid *Myrmecophana fallax* (Br.) mimicking an ant, and to the Moth *Pseudosphex hyalina* which mimics a Sphex.

ii. **Mimic.** *Mantispa* sp. Plate XIX. fig. 27.
Model. *Polistes sagittarius* (Sauss.). Plate XIX. fig. 26.

The Wasp, *P. sagittarius*, is an extremely common species and is rendered highly conspicuous by reason of a red band on the second abdominal segment; the rest of the body is black, varied on the head and thorax with a rich red-brown; the wings are fuscous, becoming flavo-hyaline outwardly. The mimic is black with the second and third abdominal segments red, the width of these two segments closely corresponding with the large second abdominal segment of the wasp; the wings are hyaline, but largely shaded with fuscous at the base and along the costal margins and flavo-hyaline at the apex (compare figs. 26 & 27). A closely allied species from Assam is in the Hope Collection at Oxford, with the MS. name of *M. nodosa* (Westw.). The specimen belonged to the Cantor Collection.

iii. **Mimic.** *Mantispa* sp. Plate XIX. fig. 25.
Model. *Polistes* sp. near *diabolicus* (Sauss.). Plate XIX. fig. 24.

The general colour of the Wasp is reddish-brown, the abdomen is covered with a fine silky pubescence golden in colour; this

[1] Ent. Month. Mag. (ser. 2) vol. xi. 1900, pp. 127 128.

pubescence is denser at the apices of the segments, forming here narrow yellow bands; the wings are flavo-hyaline, sometimes with a brown stigma.

The mimic is of a reddish hue, the abdomen is a little paler, corresponding to the red brown seen through the golden pubescence of the wasp's abdomen; the apex of each segment is narrowly banded with yellow. The wings are broadly hyaline along the costal margins and there is a brown stigma. A closely allied species from Celebes is unnamed in the British Museum.

Both this and the preceding *Mantispa* were referred to Mr. R. McLachlan, who pronounced them to be undescribed species.

iv. **Mimic.** *Mantispa ? cora* (Newm.).
Model *Mesostenus* sp.

A small black and yellow banded *Mantispa* was caught on the hill, Bukit Timah, at Singapore amongst short undergrowth, and at the same time I took also several specimens of a common Ichneumon-fly very similarly coloured. The *Mantispa* was extremely active on the wing and at first sight almost indistinguishable from its model. I append some colour notes on the two insects:-

Mantispa. -Ground-colour of head, thorax, and abdomen black, the following bands bright yellow —two vertical on the face, one transverse on the vertex, an anterior transverse and three longitudinal on the prothorax, one transverse on both meso- and metathorax, which are ventrally blotched with yellow; abdomen alternately banded black and yellow. Anterior legs yellow blotched with black, mid- and posterior femora broadly banded black and yellow. Bases of wings yellow and a distinct black stigma on the fore wings.

Mesostenus sp.—Head yellow; prothorax black bordered with yellow and with two central yellow stripes; mesothorax yellow with a central black spot; metathorax posteriorly yellow; abdomen banded alternately black and yellow. Legs yellow blotched with black. Anterior wings with a conspicuous stigma.

I subsequently found the same species of *Mantispa* or a close ally in Borneo, frequenting the blossoms of a Hibiscus; the plant was also visited in considerable numbers by a small yellow-and black *Icaria* and by a similarly coloured ichneumon-fly; a somewhat careful scrutiny was needed to distinguish these insects one from the other.

III. COLEOPTERA AS MIMICS.

I wish especially to acknowledge the kind assistance received from Mr. C. J. Gahan in working out this section of my paper.

Most of my examples are taken from the Longicornia, and I have drawn up tables of the mimetic species of the group occurring in Borneo. I have made these as complete as possible, but there are a few described species which I have not seen and which have

never been figured. Such species have been included in the appended tables, when their descriptions have shown that they do not differ in characters of mimetic importance from the closely allied species with which I am acquainted; in every case these are marked with an asterisk. I have not included a large concourse of species belonging to the subfamilies *Mesosinæ* and *Apomecyninæ*, which present in their general facies a marked resemblance to the Rhynchophora, for, although the tyro in entomology might readily mistake many of these longicorns for Rhynchophorous species, I have, nevertheless, found it quite impossible to pair any one given species with a definite model. The resemblance is in fact, as is so frequently the case, general and indefinite, not special as, for example, in the species of the subfamilies *Astatheinæ* and *Saperdinæ*, which mimic for the most part definite species of the Phytophaga. It will therefore suffice if I simply enumerate here those genera of the *Mesosinæ* and *Apomecyninæ* which present most markedly Rhynchophorous features:—

Subfam. *Mesosinæ*: –*Anancylus*, *Planodes*, *Ereis*, *Cacia*, *Mnemea*, *Sorbia*.

All these Coleoptera, more especially *Ereis anthriboides* (Pasc.), have a general resemblance to Anthribidæ.

Subfam. *Apomecyninæ*: - *Cenodocus*, *Synelasma*, *Etaxalus*, *Phesates*, *Praonetha*, *Sybra*, *Ropica*.

These bear a general resemblance to Curculionidæ.

Notes on Table I.—*Longicorns mimicking Hymenoptera.*

The subfamily *Phytæciinæ* furnishes ten and probably more species belonging to three genera which mimic the Braconidæ. The models can be divided into two sections:—(1) species with dark red head and thorax and black abdomen and wings (genus *Myosoma*); (2) reddish-ochreous species (genus *Iphiaulax*), one of which has already been shown to be mimicked by *Mantispa simulatrix*. *Scytasis nitida* (Pasc.) and four species of *Oberea* are coloured in identically the same way as their models, the red-and-black Braconids. Furthermore, *S. nitida* and three out of the four species of *Oberea* (the exception being *O. rubetra* (Pasc.)) are marked with a large white patch of pubescence on the sides of the first and second abdominal segments, which patches, when the beetle is seen in profile, give an impression of a wasp-like waist, from the posterior end of which the abdomen appears gradually to swell in size. This effect is shown in Plate XIX. figs. 13, 14, & 15, representing respectively *Oberea strigosa* (Pasc.) var., *O. brevicollis* (Pasc.), and *Oberea* probably n. sp. near *strigosa* (Pasc.). The thin waist of the model is not seen from above when the insect is at rest, being hidden by the laid-back wings, and consequently this obviates the necessity of dorsal white patches on the mimic as in the African Locustid *Myrmecophana fallax*, whose model is a wingless ant with an abdominal peduncle plainly

TABLE I.—*Longicorns mimicking Hymenoptera.*

		Mimics.	Models.
Fam. LAMIIDÆ.	Subfam. *Phytæcinæ.*	1. *Scytasis nitida* * (Pasc.).	
		2. *Oberea brevicollis* (Pasc.) (probably = *curialis* (Pasc.)	Red-and-black Braconidæ of the genus *Myosoma.*
		3. " n. sp. between *macilenta* (Pasc.) and *strigosa* (Pasc.)	
		4. " *strigosa* (Pasc.) var.	
		5. " *rubetra* (Pasc.)	
		6. " sp. near *rubetra* (Pasc.) and probably a form of it.	Reddish-ochreous Braconidæ of the genus *Iphiaulax.*
		7. " *insoluta* (Pasc.).	
		8. " *consentanea* (Pasc.).	
		9. " probably ♂ *consentanea.*	
		10. " n. sp.	
		11. *Nupserha* n. sp.	
		12. *Glenea iresine* (Pasc.)	*Hylotoma pruinosa* (Cam.).
Fam. CERAMBYCIDÆ.	Subfam. *Callichrominæ.*	13. *Nothopeus intermedius* (Gahan)	*Salius aurosericeus* (Guér.).
		14. " *fasciatipennis* (Waterh.)	*Mygnimia aviculus* (Sauss.)
		15. " sp. near *hemipterus* (Fab.)	" *anthracinus* (Sm.).
	Subfam. *Necydalinæ.*	16. *Psenida brevipennis* (Gahan)	*Myosoma* sp.
		17. *Epania singaporensis* (Thoms.)	*Melipona vidua.*
		18. " *sarawakensis* (Thoms.) *	Ants.
	Subfam. *Tillomorphinæ.*	19. *Halme cleriformis* (Pasc.)	"
		20. *Clytellus westwoodi* (Pasc.)	"

visible both in a dorsal and a profile view. A species of *Oberea* near *rubetra* (6), and probably a form of it, is really intermediate in character between these two sets of mimics, the elytra being brown anteriorly (basally) and black posteriorly. The remaining species of *Oberea* mentioned in the table mimic the reddish-ochraceous Braconids. *O. insoluta* and the species of *Nupserha* have a pale golden pubescence on the basal abdominal segments, and *O.* sp. (10) has a similarly situated greyish pubescence: in every case this coloration is not so effective as the white patches of *O. brevicollis*, &c.; but these unicolorous *Obereas* are so much more active on the wing, so much more Hymenoptera-like in their actions when resting on a leaf or twig, that when they are alive one is much more apt to mistake them for their models than their bicolorous congeners. In other words, these unicolorous *Obereas* compensate for the imperfection (from a mimetic point of view) of their coloration by their close approximation to the actions of their models. *O. consentanea* (8 & 9), *O.* sp. near *rubetra* (6), and *O.* n. sp. (10) have the elytra clothed with a delicate silky-grey pubescence, especially in the posterior two-thirds, the appearance varying according to the position in which the insect is held; and these species mimic Braconids with the outer third of the wings pale fuscous, the varying reflections of the elytra giving a similar impression to that produced by the semitransparent fuscous parts of the model's wings.

Glenea iresine (Pasc.) is a small blue species; the middle third of the elytra is brown, shading anteriorly into blue, posteriorly into greyish white; the model is a small blue *Hylotoma*, and when the wings are laid back the resemblance between the two species is striking; the blue anterior third of the beetle's elytra corresponds to the posterior part of the *Hylotoma's* thorax, the brown portion to the abdomen with the superposed wings, the greyish posterior third to the tips of the wings of the model, which project beyond the end of the abdomen.

Turning to the family Cerambycidæ, we find that the subfamilies *Callichrominæ* and *Necydalinæ* present in the reduction of the elytra a marked Hymenopterous appearance. *Nothopeus fasciatipennis* (C. O. Waterh.) has already been figured and described (Trans. Ent. Soc. 1885, p. 369, pl. x.). *Nothopeus* sp. near *hemipterus* (Fab.) is a large black species with entirely fuscous wings, and is an admirable mimic of a formidable wasp, *Mygnimia anthracinus* (Sm.), which occurs commonly on Mt. Matang. The buzzing flight and other movements of these two *Nothopei* are remarkably wasp-like and so completely deceived the Museum collectors that they employed the greatest precautions in transferring the specimens from the net to the killing-bottle.

A magnificent new species, described by Mr. Gahan in Appendix II. as *Nothopeus intermedius* (Plate XIX. fig. 21), was captured near the summit of Mt. Penrissen together with several of its models, *Salius aurosericeus* (Guér.) (Plate XIX. fig. 20).

The general colour of the beetle is reddish ochreous, the prothorax is clothed with a fine golden pubescence; the prominent black eyes, the somewhat flattened antennæ, and long hind legs closely correspond with the same organs of the *Salius*; further, the elytra, though not shortened, are much reduced in width, rapidly narrowing from a breadth of 3·5 mm. at the base to 1 mm. at the apex, so that the clear golden wings are very imperfectly hidden and add not a little to the general wasp-like appearance. When seized, this beetle curved down its abdomen in the most characteristic wasp-like manner, and it was only with the greatest reluctance and most careful precautions that my Dyak collectors, to whom I pointed out the insect, captured it. As in the *Obereas*, no representatation has here been made in dorsal view of the wasp-waist of the model, and for the same reason, namely, that this is hidden, when the *Salius* settles, by its wings, and it is only at such periods of rest that the full effect of the deceptive resemblance can be appreciated; that part, however, of the first abdominal segment of the *Nothopeus* which is visible from the side and below is clothed with a golden grey pubescence, which produces the same effect as in the *Obereas*.

It is possible that this species of *Nothopeus* is itself distasteful like the mimicked genera *Chloridolum* and *Leontium* (see later), but I could distinguish no pungent odour like that emitted by those genera, and I am inclined to think that its mimetic resemblance is its sole defence.

I have lately become acquainted with a mimetic species belonging to the subfamily *Necydalinæ* (Plate XIX. fig. 12, no. 16 in Table I.), described in Appendix II. as *Psebena brevipennis*, and I therefore add some details of its habits and of the mode in which the mimetic resemblance is attained. The species in question mimics with a remarkable degree of accuracy one of the common red-and-black Braconidæ: these Hymenoptera, as already shown, serve as models to a considerable number of species of *Oberea*, but in none of these latter is a Hymenopterous appearance so admirably borne as in this, a member of a subfamily for the most part characterized by a reduction of the elytra. The head and prothorax are of an Indian red, the wings are purplish-black, the two anterior pairs of legs are testaceous, the long slender posterior pair black with the bases of the femora white; the body is so slender that the necessity of producing a wasp-waisted effect by means of lateral white patches, as in some of the above-noted *Obereas*, can be dispensed with.

Most of the life of this beetle, as in all Longicorns with reduced elytra, is spent on the wing, when it is simply indistinguishable from its model; when it comes to rest the resemblance is still remarkably exact, and its quick restless movements and habit of flickering the antennæ in all directions are very Bracon-like. No specimen at all resembling this remarkable species has hitherto existed in the British Museum.

Of the *Necydalinæ*, one species *Epania singaporensis* (Plate

TABLE II.—*Longicorns mimicking other Coleoptera.*

	Mimics.		Models.	
LAMIIDÆ.	Subfam. *Mesosinæ.*	1. *Elelea concinna* (Pasc.)	*Arrhenodes* sp.	Fam. BRENTHIDÆ.
		2. *Zelota spathomelina* (Gah.)	*Spathomeles* sp. near *turritus* (Gerst.).	Fam. ENDOMYCHIDÆ.
	Subfam. *Dorcadioninæ.*	3. *Trachystola granulata* (Pasc.)	*Sipalus granulatus* (Fab.).	Fam. CURCULIONIDÆ.
	Subfam. *Hippopsinæ.*	4. *Alibora* sp.	*Baryrhynchus dehiscens* (Sch.).	Fam. BRENTHIDÆ.
		5. *Ægoprepis insignis* (Pasc.)	*Diurus sylvanus* (Senna).	
		6. *Ectatosia moorei* (Pasc.)	„ *shelfordi* (Senna).	
		7. *Dymascus porosus* (Pasc.)	„ *forcipatus* (Westw.).	
	Subfam. *Agniinæ.*	8. *Stegenus dactylon* (Pasc.)	„ *sylvanus* (Senna).	
	Subfam. *Saperdinæ.*	9. *Entelopes glauca* (Guér.)	Coccinellid, e.g., *Caria dilatata* (Fab.).	Fam. COCCINELLIDÆ.
		10. „ n. sp. near *wallacei* (Pasc.)	*Metrioidea apicalis* (Jac.) var.	Fam. GALERUCIDÆ.
		11. „ *ioptera* (Pasc.) *	*Caritheca* sp. near *mouhoti*. Perhaps variety only.	
		12. „ *amœna* (Pasc.)	*Aulacophora boisduvali* (Baly).	
		13. *Serixia aurulenta* (Pasc.)	*Ænidia* sp.	
		14. „ *prolata* (Pasc.)		
		15. *Xyaste invida* (Pasc.)	*Melampyrus acutangulus* (Bourg.).	Fam. LYCIDÆ.
		16. „ *torrida* (Pasc.)	*Ditoneces* sp. near *fuscicornis* (Gorh.).	
		17. „ *fumosa* (Pasc.)	Same model as 15.	

LAMIIDÆ.	Subfam. *Astatheinæ.*	18. ***Astathes unicolor*** (Pasc.)	*Antipha* sp.	Fam. GALERUCIDÆ.
		19. „ ***posticalis*** (Thoms.)	„ probably *nigra* (Ahl.) var.	
		20. „ ***flaviventris*** (Pasc.)	„ *abdominalis* (Jac.).	
		21. „ ***splendida*** (Fab.)	*Caritheca mouhoti* (Baly).	
		22. „ ***caloptera*** (Pasc.)	*Haplosonux albicornis* (Wied).	
		23. ***Tropimetopa simulator*** (Pasc.)	*Metriodia apicalis* (Jac.).	
		24. ***Ochrocesis evanida*** (Pasc.)	*Hoplasoma unicolor* (Ill.) var.	
		25. ***Chreonoma***, n. sp.	*Ænidea* sp. near *læta* (Baly).	
		26. „ ***tabida*** (Pasc.)	*Aulacophora luteicornis* (Fab.).	
	Subfam. *Phytæcinæ.*	27. *Daphisia pulchella* (Pasc.)	*Callimerus bellus* (Gorh.).	Fam. CLERIDÆ.
			„ *catenatus* (Gorh.).	
CERAMBYCIDÆ.	Subfam. *Lepturinæ.*	28. *Ephies dilaticornis* (Pasc.)	*Metriorrhynchus kirschi* (C. Waterh.).	Fam. LYCIDÆ.
	Subfam. *Pyrestinæ.*	29. *Erythrus apiculatus* (Pasc.) var.	*Lycostomus gestroi* (Bourg.).	
		30. „ *rotundicollis* (Gahan)	„ „ „	
		31. „ *sternalis* (Gahan)	„ „ „	
		32. „ *biapicatus* (Gahan)	*Metriorrhynchus kirschi* (C. Waterh.).	
		33. *Pyrestes eximius* (Pasc.)	„ *dispar* (C. Waterh.).	
		34. *Erythrus viridipennis* (Gahan)	*Prionocerus coeruleipennis* (Perty).	Fam. MELYRIDÆ.
	Subfam. *Sestyrinæ.*	35. *Collyrodes lacordairei* (Pasc.) *	*Collyris* sp.	Fam. CICINDELIDÆ.
	Subfam. *Clytinæ.*	36. *Sclethrus amœnus* (Gory)	*Tricondyla gibba* (Chaud.), var. *cyanipes*.	

XXIII. fig. 40, no. 17 in Table I.), with its swollen pedunculate posterior femora and white-tipped wings, resembles very closely the common little Dammar-bee *Melipona vidua* (Lepel.) (Plate XXIII. fig. 41); it is remarkably active on the wing and has doubtless often been passed over by collectors, the least important of its foes. *E. sarawakensis* (18) Wallace found crawling on timber, and stated "that they were remarkably ant-like"; in this species the posterior femora are not swollen.

Of the *Tillomorphinæ*, *Clytellus westwoodi* (20) and *Halme cleriformis* (19) are almost indistinguishable from ants.

Notes on Table II.—*Longicorns mimicking other Coleoptera.*

Excluding, for reasons already mentioned, the subfamilies *Mesosinæ* and *Apomecyninæ*, it will be seen that the *Saperdinæ* and *Astatheinæ* are essentially the mimetic subfamilies in this section. Most of the species are extremely common and highly conspicuous, and I have little doubt but that all are distasteful, and therefore furnish examples of synaposematic coloration (Müllerian mimicry). All the species of the genus *Entelopes* are mimetic. *E. glauca* (Guér.), red with black spots (Plate XXIII. fig. 32), is quite Coccinellid in appearance (compare fig. 30), though more by virtue of its markings than of its shape. This association of red colour with black spots is so typically a warning coloration, as exemplified by scores of species of Coccinellidæ, that it is impossible to regard the same pattern on a Longicorn as anything but pseudaposematic or synaposematic. *Entelopes* n. sp. near *wallacei* (Pasc.), an entirely reddish-fulvous species, has as its model similarly coloured species of the family Galerucidæ, *Metrioidea apicalis* (compare figs. 13 & 14, Plate XX.), which, as will be seen, serves also as model for two species of the *Astatheinæ*. *Entelopes ioptera* (Pasc.), with its yellow prothorax and blue elytra, and *Entelopes amœna* (Plate XX. fig. 26), with reddish prothorax and blue elytra, also find parallels amongst the distasteful Galerucidæ (see the accompanying Table, pp. 242, 243; also Plate XX. fig. 25). *Serixia modesta* (Pasc.) and *S. lychnura* (Pasc.) are unlike any distasteful species with which I am acquainted; the closely-allied *S. prolata* (Plate XX. fig. 12) and *S. aurulenta* (Pasc.) mimic a small reddish-fulvous Galerucid, *Ænidia* sp. (Plate XX. fig. 11). The genus *Xyaste* is interesting as it mimics beetles of quite a different nature—the Lycidæ, whose distastefulness I have proved by repeated trials with various small mammals and birds. *Xyaste* is generically separated from *Serixia* by the thickened and pilose basal joints of the antennæ; the remaining joints, being of exceeding fineness, are more or less inconspicuous; and it is by this means that the thickened, flabellate, and short antennæ of the Lycidæ are simulated, whilst *Ephies dilaticornis* (Plate XXIII. fig. 18) and *Erythrus apiculatus* var. (Plate XXIII. fig. 8), also mimetic of Lycidæ, have the antennæ shortened and dilated in almost the same manner as their

models. *Xyaste invida* (Plate XXIII. fig. 26) and *X. fumosa* (Plate XXIII. fig. 25) are black with the basal half of the elytra reddish; a similarly coloured Lycid model, *Melampyrus acutangulus* (Bourg.) (Plate XXIII. fig. 23), is common round Kuching. *X. torrida* (Pasc.) is brownish-testaceous with a corresponding brownish-testaceous model—*Ditoneces* sp. (Plate XXIII. fig. 29). Of the Astatheinæ, *Astathes unicolor* (Pasc.) (=*coccinea* Pasc.), a large species with purplish reflections on the elytra (Plate XX. fig. 18), has unmistakable models in similarly coloured Galerucids—*Antipha* sp. and *Ochralea nigripes* (Plate XX. fig. 17). The next three species *A. posticalis* (Plate XX. fig. 22), *A. flaviventris* (Pasc.), *A. splendida* (Plate XX. fig. 20)—all closely resemble each other, being dark shining blue anteriorly, red posteriorly; *flaviventris*, as its name signifies, has a yellow abdomen, whilst *splendida* has a red head and prothorax. The latter species mimics an equally resplendent Galerucid—*Caritheca mouhoti* (Plate XX. fig. 19), and the slight differences between *A. flaviventris* and *A. posticalis* are paralleled in two closely-allied Galerucidæ—*Antipha abdominalis* (Jac.) and *A. ?nigra* (Alld.) var. (Plate XX. fig. 21), the former of which alone has a yellow abdomen. *A. caloptera* (Pasc.), a blue species, finds a model in *Haplosonyx albicornis* (Wied.) (compare figs. 23 & 24, Plate XX., and see explanation of this Plate for a few further examples given in Table II. but not again mentioned in the text).

The remaining genera of the subfamily, as represented in Borneo, have corresponding models, also among the Galerucidæ, the resemblance between *Ochrocesis evanida* (Pasc.) and its model, *Hoplasoma unicolor* (Ill.) var. *ventralis* (Baly), being very exact. All these genera *Tropimetopa*, *Chreonoma*, and *Ochrocesis* are unicolorous, and form with the unicolorous *Saperdinæ* and numerous[1] Galerucidæ and Halticidæ a large group of similarly coloured beetles, all of which I consider to be distasteful.

The subfamily *Hippopsinæ* contains four species, each mimetic of a species of the Rhynchophorous family Brenthidæ. The first, *Alibora* sp., mimics *Baryrrhynchus dehiscens* (Sch.) (compare fig. 3 with 1 & 2, Plate XX.). The general colour of both model and mimic is a rich chestnut-brown, variegated on the elytra with bright yellow streaks and spots; the three basal joints of the antennæ of the Longicorn are clothed biramously with long and close-set hairs. In the natural attitude the elongated scapes are closely pressed together, the remaining joints gradually diverging, the result being a remarkable resemblance to the head with its elongated rostrum and shorter antennæ of the Brenthid, which only a closer examination proves to be deceptive; the short legs of the mimic add still further to the resemblance.

All the other three species of *Hippopsinæ* mimic extremely common species of the Brenthid genus *Diurus* (Plate XX.

[1] I have not included in the table all the unicolorous Galerucidæ and Halticidæ with which I am acquainted; those that are included are merely typical examples.

figs. 4, 5, 6). The Brenthids are extremely variable in both sexes, in the matter of size, in the shape and length of the terminal processes of the elytra, and in the amount of scaling on the head and antennæ. The three species here noted range in length from ·75 in. to 1·5 in.; and it is of exceptional interest that three mimetic Longicorns of sizes corresponding closely to these forms should be found in a more or less closely circumscribed area, and all belonging to the same subfamily.

In the first couple *Diurus sylvanus* (Senna) (a female) measures 1·5 in. in length, and the mimic *Ægoprepis insignis* (Pasc.) is of corresponding length (compare figs. 4 & 7 on Plate XX.). Both species are dark brown, relieved with pale ochreous streaks and spots; the Brenthid has the prothorax and elytra densely and deeply punctured, the punctures on the elytra being arranged in close-set rows. Both on the prothorax and elytra each puncture is occupied by a peculiar scale, lenticular in shape and pale ochreous in colour; these produce the pale ochreous streaks characteristic of the beetle (fig. 4 a). The head and antennæ are covered by similar scales, more closely set and not imbedded in punctures; each elytron terminates in a somewhat sharp point, the homologues of the long, narrow, terminal processes of the male.

The mimic has the ground-colour of the prothorax and elytra black, and their dorsal surfaces are covered with tufts of a fine pale ochreous pubescence (fig. 7 a); these represent very well the scales of the Brenthid, and a very similar mottled appearance is thus produced in both species by totally different means. The elytra of the Longicorn do not terminate in sharp points corresponding to the points of the Brenthid's elytra, as in the two species mentioned below. The rostrum of the model is slightly longer than in *Baryrhynchus dehiscens*, but the antennæ are shorter and thicker; and similarly we find that the antennæ of the mimic, which, when carried in the natural attitude (*i. e.*, pointing forward and closely apposed), simulate the rostrum and antennæ of the Brenthid, are plumose for a greater part of their length than in *Alibora* sp., whilst the free portion is short and thick, not long and setaceous as in the *Alibora*. Both model and mimic were taken on a fallen log close together.

Ectatosia moorei (Pasc.) is a mimic of *D. shelfordi* (Senna) (♀), a species of medium size, 1 inch in length (compare fig. 10 with 6 and 10 a with 4 a on Plate XX.). The simulation is as perfectly carried out and by the same means as in *Ægoprepis insignis*, with this addition, that the elytra terminate in sharp points corresponding to the same points in the Brenthid. The length of the mimic from elytra tips to termination of the plumosity of the antennæ is approximately the same as the length of the model from elytra tips to tip of the rostrum.

Another and a smaller species, *Dymascus porosus* (Pasc.) (Plate XX. fig. 9), mimics—again by the same means—a small *Diurus forcipatus* (Westw.) measuring only ·75 inch in total length

(fig. 5). The model may be a male or female, as in such small-sized specimens the male does not bear the long elytral processes characteristic of large or medium-sized varieties, the elytra are merely produced into short points; these short points are mimicked by the Longicorn very exactly.

Stegenus dactylon (Pasc.) of the subfamily *Agniinæ* is also a fair mimic of a large-sized *Diurus sylvanus* (compare figs. 8 & 4 on Plate XX.). As in *Ægoprepis insignis*, the body is blackish-brown streaked with a pale ochreous pubescence (fig. 8 a); the basal two-thirds of the antennæ are clothed with a dense black plumosity; the remaining joints are ochreous and pale in colour.

Elelea concinna (Pasc.), one of the *Mesosinæ*, also mimics in the same manner a small Brenthid, *Arrhenodes* sp., as previously noted by Wallace, who remarks that it carried its antennæ "straight and close together, appearing like a Brenthid."

Another of the *Mesosinæ*—*Zelota spathomelina* (described by Mr. Gahan in Appendix I. to this memoir)—mimics an Endomychid, a species of *Spathomeles* near *turritus* (Gerst.) (compare figs. 57 & 56, Plate XXIII.). The model, which is not represented in the British Museum collections, is pitchy-black with two reddish spots on each elytron; springing from each elytron is a stout spine directed somewhat forwards, forming a very efficient defence against the attacks of enemies. It is not improbable, moreover, that this beetle is still further protected by some distasteful properties, which, at any rate, are possessed by the species of the genus *Eumorphus* of the same family, an assemblage of black or purplish insects with conspicuous yellow spots. All of these possess a very pungent though not altogether disagreeable odour, whilst many exude a yellowish acid fluid when seized. The mimic of the *Spathomeles* is coloured in much the same way as its model: on each elytron there is a mamilliform prominence, from which springs a pointed tuft of delicate hairs, which is curved slightly forwards. These tufts so closely resemble the formidable spines of the model that a near inspection with lens and finger is necessary to reveal the deception. Another Endomychid beetle, *Amphisternus mucronatus* (Gerst.), is also a probable model of the same species of Longicorn.

The aberrant *Trachystola granulosa* (Pasc.), which was placed provisionally in the subfamily *Dorcadionina*, with its deeply punctured and granulate elytra, presents the general appearance of a large black Curculionid, such as *Sipalus granulatus* (Fab.), without, however, exhibiting any very highly modified mimetic characteristics, as in the species previously discussed.

Daphisia pulchella (Pasc.) is a highly conspicuous little beetle of the subfamily *Phytæciinæ*, and is almost indistinguishable from two species of Clerid of the genus *Callimerus* (compare fig. 55 with figs. 53 & 54 on Plate XXIII.).

[The resemblance of the Cleridæ as a group to widely different Coleoptera and to insects of other orders is well known. Looking

through the fine collection in the Hope Department, two chief types of deceptive coloration were seen to be predominant, viz., that of Mutillidæ and Cantharidæ. While the constant repetition of a single very distinctive Hymenopterous type is remarkable, it must not be forgotten that the Cantharid appearance, orange with black transverse bands, is furthermore strongly suggestive of one of the commonest and most conspicuous types of colouring in the Hymenoptera Aculeata. In addition to these predominant types other deceptive resemblances were common, viz., to Phytophaga, Lycidæ, ants, and apparently, in the case of certain Australian species, to Cetoniidæ. All the species of the interesting genus *Allochotes* (Westw.) were Coccinelliform. The interesting question arises as to whether these resemblances are Batesian (pseudaposematic) or Müllerian (synaposematic). The latter interpretation is strongly supported by the interesting discovery by Mr. Shelford of the mimicry by the Longicorn *Daphisia* of two species of the Clerid genus *Callimerus*, possessing an independent warning coloration. The conspicuous appearance, abundance, and habits of the species of this genus are entirely consistent with the explanation of their colours and pattern as aposematic. Fig. 49 on Plate XXIII. shows a Clerid, *Tillicera* sp., resembling a Mutillid, near *Urania* (Sm.) (fig. 48); fig. 52 a Clerid, *Tenerus sulcipennis* (Gahan), resembling a Lycid, *Metriorrhynchus atrofuscus* (fig. 50 & 51); while figs. 53 and 54 show the Clerid species of *Callimerus* resembled by the Longicorn. The whole group was obtained by Mr. Shelford from the vicinity of Kuching, and it strongly suggests that the Clerid mimics (figs. 49 & 52) are really synaposematic.—E. B. P.]

In the Cerambycidæ, *Collyrodes lacordairei* (Pasc.) is the most remarkable mimic of the Cicindelan genus *Collyris*. *Sclethrus amœnus* (Gory) is also remarkably like the genera *Tricondyla* and *Collyris* with its dark blue body and bright red legs, of which the hind pair are considerably elongated (compare fig. 11 with 5 and 3 on Plate XIX.). It is much less common than its model, but is found in the same situations and always tries to escape its captor by running swiftly just like the *Tricondyla*. The other five species mentioned in this section of the table, *Ephies dilaticornis* (Pasc.), the three species of *Erythrus*, and *Pyrestes eximius* (Pasc.), mimic species of the Lycidæ (see group of figs. 4 to 8, 12, 19, Plate XXIII.). *P. eximius* with its elongated prothorax is perhaps less Lycid in appearance than the other species.

Erythrus viridipennis, with black head, red thorax, and green elytra, is a mimic of one of the Melyridæ, similarly coloured, *Prionocerus cœruleipennis* (Perty) (Plate XXIII. figs. 58 & 59). All these species of *Erythrus* were taken in great abundance on Mt. Matang, and I am strongly of opinion that the entire subfamily *Pyrestinæ* is a distasteful one: the mimicry in this case is therefore Müllerian. *Ephies dilaticornis*, on the other hand, I am inclined to regard as a Batesian mimic; it is rare, a closer mimic, and belongs to an essentially mimetic subfamily (*cf.* Table III.).

TABLE III. - *Longicorns mimicking Longicorns.*

Family	Subfamily (Mimics)	Mimics	Models	Subfamily (Models)
Fam. LAMIIDÆ.	Subfam. *Acanthocininæ.*	1. *Driopea clytina* (Pasc.)*	*Clytanthus* sp.	Subfam. *Clytinæ.*
	Subfam. *Lamiinæ.*	2. *Cylindrepomus peregrinus* (Pasc.)	*Xylotrechus pedestris* (Pasc.).	
		3. ,, *comis* (Pasc.) & sp. near it	*Chlorophorus (Clytanthus) annularis* (Pasc.).	
	Subfam. *Saperdinæ.*	4. Gen. ? and sp. ?	*Chloridolum thomsoni* (Pasc.) & sp. near it.	Subfam. *Callichrominæ.*
	Subfam. *Phytæciinæ.*	5. *Daphisia* sp.	*Chlorophorus annularis* (Pasc.).	Subfam. *Clytinæ.*
		6. ,, sp.	*Demonax viverra* (Pasc.).	
		7. *Ossonis clytomina* (Pasc.)	*Clytanthus sumatrensis* (Lap. & Gor.).	
		8. *Cryllis clytoides* (Pasc.)	,, ,, ,,	
		9. *Chlorisanis viridis* (Pasc.)*	*Chloridolum thomsoni* (Pasc.) & sp. near it.	Subfam. *Callichrominæ.*
Fam. CERAMBYCIDÆ.	Subfam. *Œmiinæ.*	10. *Xystrocera alcyonea* (Pasc.)	*Chloridolum thomsoni* (Pasc.) & sp. near it.	
	Subfam. *Disteniinæ.*	11. *Psalanta chalybeata* (Pasc.)*	*Chloridolum* sp.	
	Subfam. *Lepturinæ.*	12. *Leptura* probably n. sp.	*Chloridolum cinnyris* (Pasc.).	
		13. ,, sp. near *histrionica* (Pasc.)	*Xylotrechus decoratus* (Pasc.).	Subfam. *Clytinæ.*
		14. ,, sp.	*Demonax mustela* (Pasc.).	
	Subfam. *Glaucytinæ.*	15. *Polyphida clytoides* (Pasc.)*	*Demonax viverra* (Pasc.).	

In the Cerambycidæ, the antennæ present great diversity of form—flabellate in *Cyriopalus*, thickened in *Epipedocera* and *Ephies*, short in *Demonax*, *Clytus*, and many other genera, enormously elongate in *Neocerambyx æneas*; and we find, perhaps as a consequence of this plasticity of the antennal form, a close resemblance in structure and external appearance between the antennæ of the mimetic Cerambycidæ and their models (*e.g.*, compare antennæ of *Nothopeus intermedius* and *Ephies dilaticornis* (Pasc.) with the antennæ of *Salius auroserieeus* and the Lycid *Metriorrhynchus kirschi* (C. Waterh.) respectively): whereas in the family Lamiidæ, nearly all the members of which are characterized by setaceous or linear antennæ, the simulation of the differently constructed antennæ of their models, if attained at all, is not brought about by actual resemblances in form, but by such devices as pilosities, modes of holding, or the thinning away of a portion of the length until it becomes almost invisible in comparison with a specially thickened portion (compare the antennæ of *Alibora*, *Ægoprepis*, &c., and of *Nyaste invida* with those of their respective models).

NOTES ON TABLE III.—*Longicorns mimicking Longicorns.*

The only two subfamilies of the Longicornia which serve as models to the other subfamilies are the *Callichrominæ*, a group of metallic-green beetles protected by a powerful odour, which is produced by glands behind the metasternum opening to the exterior by two pores, and the *Clytinæ*. This latter subfamily includes the well-known *Clytus arietis* (L.), mentioned in many works on natural history as mimetic of a wasp. Whether this is a case of Mullerian or of Batesian mimicry can only be proved by experiment, but I am quite confident that the Bornean representatives of the group are all highly distasteful. The extremely conspicuous and strikingly coloured *Chlorophorus* (*Clytanthus*) *annularis* (Plate XX. fig. 31) was the commonest beetle on Mt. Penrissen at all elevations: some shrubs simply swarmed with it, while its movements and its very presence in such numbers spoke eloquently of some protective characteristic. Species of the genus *Demonax* were almost equally common on the mountain, whilst around Kuching the species *Clytanthus sumatrensis* (Plate XX. fig. 37) and *Demonax viverra* (Plate XX. fig. 35) are amongst the commonest Longicorns met with. Such few experiments as I have conducted have yielded negative results. During my collecting expedition to Mt. Penrissen I naturally had no tame animals with me, and therefore was unable to experiment with *Chlorophorus annularis*, whilst in Kuching the species of *Demonax* and *Clytanthus*, though common enough, are never obtainable in large enough quantities at one time, a very necessary consideration when one experiments with that most inquisitive of animals, the common Macaque (*Macacus cynomolgus*),

which will devour a single specimen of beetle or butterfly entirely for the sake of curiosity, only manifesting disgust or the reverse when that curiosity is fully satisfied.

Of the mimicking species it is not necessary to say much, their resemblances to their models being in every case most obvious.

Amongst the Lamiidæ, the *Phytæcinæ* again yield the majority of mimetic species (a newly-discovered *Daphisia*, yellow in colour, is banded with black in almost identically the same manner as *C. annularis*) (compare figs. 34 & 31 on Plate XX.); and amongst the Cerambycidæ, the *Lepturinæ* are also fruitful in this respect. One species of *Leptura*, with reddish head and prothorax and yellow black-banded elytra, is closely similar to *Demonax mustela* (compare figs. 40 & 39, Plate XX.): another species allied to *Leptura histrionica* (Pasc.), black with cream-coloured bands, is not readily distinguishable from *Xylotrechus decoratus* (compare figs. 42 & 41) and one or two species of *Demonax*. Plate XX. and its explanation should be consulted for the representation of other examples given in Table III. but not further indicated in the text. *Polyphida clytoides* (Pasc.), *Psalanta chalybeata* (Pasc.), and *Chlorisanis viridis* (Pasc.) I have never seen, but good figures of them are published in Pascoe's paper on the Longicornia Malayana (Trans. Ent. Soc. ser. 3, vol. iii.). The remaining mimics of the iridescent green *Callichrominæ*, viz. Nos. (4), (10), and (12) in Table III., are shown in figs. 47, 48, and 44 on Plate XX. and their models in figs. 45, 46, and 43.

[The mimetic resemblance to the *Clytinæ* exhibited by so namy species of distantly related Bornean Longicorns is of extreme interest. The widespread species of this dominant group have developed, in a great majority of cases, a black and yellow or black and orange transverse banding, which superficially resembles the characteristic appearance of wasps and hornets. This rough resemblance is further heightened by the active movements of the living beetle, which suggest those of a Hymenopterous rather than a Coleopterous insect. Such an appearance is found in *Clytinæ* of many species from the whole Palæarctic and Nearctic belt, from Mexico, Malaya, Australia, and probably many other countries. An Australian species, *Aridæus thoracicus* (Donovan), has the deep brownish-orange colour of the alternate stripes, as well as the comparatively few broad black bands which are characteristic of wasps from the same region. *Clytanthus sex-guttatus* (Lucas) from Morocco suggests the appearance of a Mutillid or perhaps a Clerid with a Mutillid form of colouring. The Bornean *Sclethrus amœnus* (Gory) mimics the aggressive Coleopterous *Tricondyla* (Cicindelidæ), while species of the *Tillomorphinæ*, allied to the *Clytinæ*, mimic ants, e. g., *Euderces picipes* (Fab.) of N. America and *Clytellus westwoodi* (Pasc.) of Borneo. Thus we witness within the limits of one large group of Coleoptera a great development of mimicry of aggressive specially protected forms. Such mimicry has been hitherto assumed to be Batesian (pseudaposematic), although the dominance

of the group in which it is manifest, the abundance and wide range of individuals in the species as well as of the species themselves, together with the remarkable predominance of mimetic resemblances among them—all tended to create a strong suspicion that the mimicry is Müllerian (synaposematic). This suspicion is now justified. The discovery of many Bornean Longicorn mimics of *Clytinæ* renders it in every way probable that the group is specially defended by some unpalatable quality, and sometimes develops warning colours of its own which are deceptively resembled by other beetles, although it usually makes use of warning colours which are common to more aggressive and even more highly-protected insects. Thus the conclusions which were found to hold in the case of the Cleridæ (p. 248) also apply, with equal probability, to the *Clytinæ*. Since the above was written Mr. Gahan has shown me a beautiful example of Batesian or Müllerian mimicry within the group of *Clytinæ*, the common *Demonax walkeri* (Pasc.) being resembled in the closest manner by the rarer *Perissus myops* (Chev.). Both beetles had come to the British Museum in a single consignment from Ceylon. There is similarly a very remarkable resemblance, probably Müllerian, between *Xylotrechus pedestris* and *Demonax viverra* (compare figs. 29 & 35 on Plate XX.).—E. B. P.]

Coleoptera other than Longicorns as Mimics.

Mimic. *Tillicera* sp., near *bibalteata* (Gorh.) (Fam. Cleridæ). Plate XXIII. fig. 49.

Model. *Mutilla* sp. near *urania* (Sm.). Plate XXIII. fig. 48.

The *Mutilla* has a red head and thorax and black abdomen, the second abdominal segment bears a white spot, the third segment is covered with a creamy white pubescence. In the beetle, the eyes and front of head are black, the vertex of the head and the prothorax are red; the elytra are black with one white band replacing the white spot and another sub-apical band paralleling the white abdominal segment of the *Mutilla*. Curiously enough, the male of this species of *Mutilla* bears a white band in place of a white spot, and hence the beetle more closely approaches the male than the female in its markings: still there is no question as to which sex serves as the model in this case.

Several specimens of the same species of *Tillicera* and of a closely-allied one are in the Hope Collection, Oxford, all collected by Dr. A. R. Wallace in Sarawak.

IV. LEPIDOPTERA AS MIMICS.

So much has been written, by abler pens than mine, on mimicry amongst the Eastern Lepidoptera *inter se*, that I have confined myself to drawing up merely a table of such mimetic species as occur in Borneo, with the addition of a few notes on the bionomics of certain species. Three remarkable examples of lepidopterous

mimics which came under my observation—namely, a sphingid larva mimicking a snake, a noctuid larva mimicking an ant, a moth mimicking a plant-bug—deserve, however, further notice and are here described at length.

i. **Mimic.** Larva of *Chærocampa mydon* (Walk.).

Model. A Snake, e. g. *Dendrophis picta* (Gm.).

I must confess that I have always hitherto regarded as somewhat fanciful those recorded cases of lepidopterous larvæ mimicking snakes and other vertebrate animals, though experiments have shown that the resemblances, even when imperfect, serve to rouse respectful curiosity, if not actual terror, in prospective enemies. I was therefore singularly delighted to secure a larva whose resemblance to a snake was so startlingly accurate that I was for a moment completely deceived.

The general colour was a dark olive-brown, becoming lighter anteriorly: the head, the first and second and the dorsal surface of the third and fourth segments were pinkish; at the junction of the third and fourth segments on each side was an ocellus, not a huge black disc, out of all proportion to the mimicked head, as in all the recorded similar examples, but of very nearly the exact size of the eye in such a snake as *Dendrophis picta*: the lower border of this was margined with bright gold (the colour of the iris in many snakes), giving an upward look and a most malevolent cast to the countenance; the black of the ocellus was so intense and glossy that an idea of depth was given, and it was difficult to believe that one was not looking through a cornea into a pupil. Running through the ocellus on each side was a broad black stripe exactly as in *Dendrophis picta*, while a wrinkled fold on each side of the lower half of the second, third, and fourth segments gave an admirable impression of the division between the upper and lower jaws of a snake. Not the least remarkable of these extraordinary devices was the flatness of the area bounded by the two "eye-stripes" on the dorsal surface of the third and fourth segments; this area together with the first and second segments were pink, reticulated with fine brown lines and strokes, giving an impression of the scutes on a snake's head; they were particularly well-marked on the first and second segments, being there more distant and distinct, and looking extremely like the divisions between internasal and præfrontal shields.

When the larva was moving about with the anterior segments well expanded, the resemblance to a snake was not so startling, but directly it was touched the terrifying attitude was assumed, the anterior segments being drawn in and the front of the body turned towards the aggressor; when, at the same time, the posterior part of the body was hidden by leaves the deception became complete, and if effective enough to deceive, even temporarily, a human being, it must surely be equally effective in deterring less highly organized and more timid foes.

Unfortunately I was unable to test the efficacy of the disguise for fear of losing the larva, which I was anxious to rear for the purpose of identification.

ii. **Mimic.** *Larva of a Noctuid Moth* (? Genus *Tinolius*).
Model. An Ant, *Œcophylla smaragdina* (Fab.).

In Jan. 1900 a curious Noctuid larva of the subfamily *Quadrifinæ* was pointed out to me by Mr. H. N. Ridley in the Botanic Gardens, Singapore, resting on a leaf of a tree much frequented by the common red ant *Œcophylla smaragdina.*

Nearly all the segments of the body are furnished with fragile tentacle-like processes which are capable of quivering movements, and so loosely attached that very careful handling was necessary to secure a perfect specimen.

The arrangement of these tentacles is as follows:—

Segment 1. 3 pairs: 1 pair lateral, 2 pairs dorsal pointing forwards.
" 2. 3 pairs: 1 pair lateral, 1 pair sub-lateral, 1 pair dorsal.
" 3. 2 pairs lateral.
" 4. Unprovided with tentacles.
" 5–10. Each with 1 lateral pair.
" 11. 2 lateral pairs.
" 12. 1 lateral pair.
" 13. 2 lateral pairs, the most anterior being very delicate, the most posterior strong and curved backwards.

Segment 8 is dorsally produced into a sharp-edged prominence. The anal prolegs are somewhat disproportionately large and can be widely divaricated; just above each is a prominent black spot: the colour of the body is brown of the exact shade of the *Œcophylla*, with a narrow yellow line on each side. When the larva is irritated, the posterior part of the body is immediately reared in the air, the anal prolegs are thrown widely apart and the tentacles, especially the most posterior pair, are violently agitated. When the caterpillar is seen in an end-on position or when the anterior two-thirds of the body are hidden, the resemblance to the ant is positively startling: the black eye-spots represent the eyes, the widely-diverging anal prolegs, the gaping jaws and the tentacles, the antennæ and legs of the model; the posterior pair of tentacles are so curved that they represent very accurately the elbowed antennæ of the ant.

It might be thought essential, in cases of mimetic lepidopterous larvæ such as the two examples just described, that the greater part of the body should be concealed in order perfectly to deceive prospective enemies: for example, in the sphinx-moth larva it is only the head of the snake that is copied, but is it necessary for the larva, in order to obtain immunity, that it should conceal its disproportionate shortness of body, thus arguing for it a degree

of appreciation of its shortcomings with which such lowly organisms are not usually credited? It seems to me more reasonable to compare such mimetic examples to the pictures of a painter, who strives not to make an exact copy of a scene or object, but to give an essential idea or impression of it, unintelligible perhaps to many, but full of significance to those for whom a picture is more than a mere photograph in colours.

[It is not necessary to adopt the improbable view that the caterpillar has any "appreciation" of the situation, even if we may reasonably believe that the mimetic resemblance is aided by partial concealment. A larva living among leaves is apt to be partially concealed by them and to be protected by the concealment. The appropriate attitude would arise through natural selection without the intervention of intelligence on the part of the larva.—E. B. P.]

The *Œcophylla*, one would imagine, has firmly established a reputation for ferocity, and consequently the mimicking Geometer larva can the more easily deceive its enemies, in spite of its too elongate body. Only two specimens were found, both were walking on leaves and were readily distinguishable; but the violently threatening attitude each assumed when irritated was unmistakable, and the resemblance of the elevated posterior end to the ant so striking, that it is difficult to imagine how a lizard or frog with a previous experience of the ant could fail to be deterred.

I shall have later to draw attention to a Spider which mimics the same ant, but this is a case with a different significance, viz., that the mimic may be enabled to prey undisturbed on its model.

It is a curious coincidence that, in both the larva and the spider, it is the posterior end that mimics the head of the ant — a coincidence which possibly has its meaning.

iii. **Mimic.** *Phauda limbata* (Wllngrn.). Plate XXIII. fig. 3.
Model. *Serinetha abdominalis* (Fab.). Plate XXIII. fig. 2.

The head, thorax, and coriaceous part of the elytra are, in this Hemipteron, of a bright vermilion-red, whilst the membranous part of the elytra, the legs, and antennæ are black. The moth has the head, thorax, costal margin, and basal half of the fore wings also vermilion, with the remaining portion black, the hind wings are coloured in the same way. I had long been familiar with the moth from cabinet specimens, but until I went to Singapore and saw the insect alive I had not suspected the significance of this very striking coloration. When the moth is in a state of repose, resting, for example, on a plant stem, the wings are laid back and overlap in the characteristic moth-like manner, and in this attitude the resemblance to the bug is very striking (compare figs. 3 & 2, Plate XXIII.). The hind wings, although entirely hidden, nevertheless serve the purpose of giving an impression of complete opacity to the fore wings, the red and black areas of which in this attitude overlap the similar areas of

TABLE IV.—*The Pseudaposematic and Synaposematic Species of Bornean Lepidoptera.*

Models.	Mimics.				
Subfam. *Danainæ.*	Subfam. *Nymphalinæ* [? pseudaposematic].	Subfam. *Elymniinæ* [pseudaposematic].	Subfam. *Papilioninæ* [chiefly pseudaposematic].	Subfam. *Pierinæ* [synaposematic].	Subfam. *Chalcosiinæ* [synaposematic].
Ideopsis daos			*Papilio delesserti* ♀		*Isbarta pieridoides* (Herr-Schaff.).
Radena vulgaris	*Euripus halitherses* ♂	*Elymnias lais* ♂	*Papilio megarus.*		
Radena juventa			*Papilio delesserti* ♂.		
Limnas chrysippus	*Hypolimnas misippus* ♀.				
Tirumala septentrionis.			*Pap. macareus macaristus.*		
Bahora aspasia				*Nepheronia lutescens* ♀.	
Caduga larissa *Parantica eryx*		*Elymnias lais* ♂.			
Tronga crameri	*Hypolimnas anomala* ♂.	*Elymnias aroa*, n. sp.	*P. paradoxus telesicles* ♀, var. *russus.* *P. paradoxus telesicles* ♀, var. *leucothoides.* *P. leucothoe ramaceus.*		*Isbarta macularia* ♀.
Adigama scudderi					*Amesia hyala.*
Penoa zonata			*Pap. slateri hewitsoni.*		
Penoa menetriesii		*Elymnias lutescens*			*Mimeuplœa tristis* (Jordan).
Trepsichrois mulciber ♂	*Euripus halitherses* ♀, var. *cinnamomeus.* *Hypolimnas anomala* ♀	*Elymnias borneensis.*	*Pap. paradoxus telesicles* ♂.		*Pompelon subcyanea.* *Callamesia striata* ♂.
" " ♀		*Elymnias lais* ♀	*Pap. paradoxus telesicles* ♀.		*Callamesia striata* ♀.

Danisepa lowei ♂	*Euripus halitherses* ♀, var. *pfeifferæ*	...	*Papilio caunus mendax* ♂.		
" " ♀	*Euripus halitherses* ♀, var. *euplæoides*	...	*Papilio caunus mendax* ♀.	...	*Mimeuplæa rhadamanthus.*
Isamia ægyptus	same models as those of *E. crameri.*				
Subfam. *Pierinæ.*					
Delias pandemia . .	...	...	...	.	*Isbarta pandemia.*
Delias aglaia	...	*Elymnias godferyi*	...	...	*Isbarta dissimulata.*
Delias cathara	...	...	...	...	*Callamesia pieridoides* (Walk.).
Delias singhapura	...	...	...	*Prioneris cornelia.*	
Terias sari or *T. nicobariensis.*	...	...	...	...	*Isbarta inclusus.*
Subfam. *Papilioninæ.*					
Papilio aristolochiæ antiphus	...	...	*Papilio polytes theseus* ♀.		
Papilio erebus...... . ..	...	...	*P. memnon* ♀, var. *erebinus*		
Papilio noctis	...	...	*Papilio memnon.*		
Fam. AGARISTIDÆ.					
Scrobigera hesperioides	*Cethosia hypsea*	...	...	...	*Eterusia obliquiaria.*
Fam. GEOMETRIDÆ.					
Euschema subrepleta .	...	...	...	...	*Canerces gloriosus.*

the hind wings. Both mimic and model were taken in daytime in the Botanic Gardens, Singapore, and both were equally conspicuous; subsequently both species were found in Sarawak[1].

The following species are discussed below: —

	Mimics.	Models.
Subfam. *Nymphalinæ.*	*Symbrenthia hippoclus* with the mountain forms. *S. hypatia* var. *hippocrene* and *S. hypselis* var. *balunda.*	Yellow-and-black *Neptis*, e.g. *N. hordonia*, *N. tiga* &c.
	Athyma spp.	White-and-black *Neptis.*
Fam. LYCÆNIDÆ.	*Thrix gama*	*Eoxylides tharis.*
	Poritia plateni *Araotes lapithis* .	*Drupadia boisduvalii* var. *atra.* *Biduanda thesmia.*

Notes on Table IV.

The females of *Euripus halitherses* (D. & H.) are extremely variable, in fact no two specimens of the fine series of this species in the Sarawak Museum collection are exactly alike, and almost every specimen deserves a varietal name of its own, as has been done to a certain extent for the mimetic *Papilio paradoxus telesicles* (Feld.) by Rothschild & Jordan (Nov. Zool. vol. ii.).

It is possible, however, to distinguish three main groups. One, almost entirely dark blue, is a mimic of *Trepsichrois mulciber* (Cr.), and approximates to *E. cinnamomeus* (Wood-Mason). Another is dark brown with a blue gloss and an oblique discal white fascia on the fore wings and some white streaks on the hind wings, and is a close mimic of *Danisepa lowei* (Butl.) ♂; this group is nearest to *E. pfeifferæ* (Feld.). The third group, near *E. euplœoides* (Feld.), corresponds closely in coloration and markings with *Danisepa lowei* ♀. A considerable number of variations of this highly variable species have been separated into distinct species, but I prefer to regard these as merely varietal names.

The females of *Danisepa rhadamanthus* (Fab.) (the continental form of *Danisepa lowei*) have much more white on the upper side and are readily distinguishable from the Bornean representatives, though the males are practically indistinguishable. In accordance with this, the continental forms of *Euripus halitherses* ♀ of the *euplœoides* type have larger white markings on the upper side than the insular forms; I have not seen continental forms of *Isbarta rhadamanthus* (Fab.) or of *Papilio caunus* (Westw.), but I expect that a parallel variation will be found in these. It is curious that the almost identical males of *D. rhadamanthus* and *D. lowei* are extremely common in their respective localities, whilst, on the other hand, the female of *D. lowei* is very rare, and the very different female of *D. rhadamanthus* is as common as its male.

Hypolimnas anomala (Wall.) is very Euplœine in its flight as well as in appearance; it is not an uncommon species and the

[1] [A closely similar example of Müllerian mimicry was sent for exhibition to the Entomological Society in 1894 by Mr. G. A. J. Rothney (see Proc. Ent. Soc. Lond. 1894, p. xv). The species *Phauda flammans* (Walk.) and *Serinetha augur* (Fab.) were observed in abundance on roots and trunks of trees in Mysore in Nov. 1893 by Mr. Rothney.—E. B. P.]

resemblance is possibly synaposematic. There are, at any rate, some good grounds for supposing that *H. misippus* (L.) is a Mullerian mimic of *Limnas chrysippus* (L.). (See Poulton: "Mimicry in Butterflies of the Genus *Hypolimnas*," Proc. Am. Assoc. Adv. Sci. 1897, vol. xlvi. p. 242.)

Elymnias nigrescens (Butl.) and allied species are in India and elsewhere mimics of *Euplœinæ*; no *Euplœinæ* serving as models to *E. nigrescens* occur in Borneo, though the species is common enough. The subfamily *Elymniinæ* is an interesting one, as affording examples of species endowed with a double means of protection against the attacks of their enemies. The majority of the Bornean species are on the upper side good mimics of Euplœine or Pierine models, whilst on the under side they are mottled with grey and brown, so that when at rest they are indistinguishable from their surroundings.

Elymnias lais (Cr.) occurred on Mt. Penrissen, and I had ample opportunities of observing something of its habits. The male is black above with green streaks, a common type of coloration amongst the *Danainæ* (e. g., *Radena vulgaris* (Butl.), *Caduga larissa* (Feld.), *Parantica eryx* (Fab.), &c., &c.), whilst the under side is mottled. The female is a mimic of *Trepsichrois mulciber* (Cr.) ♀, but I have never seen this sex alive. The green-and-black Danaines *Caduga larissa* (Feld.) and *Parantica crowleyi* (Jenner Weir) were abundant on Mt. Penrissen, so much so, indeed, that after two days' collecting they were left in peace. Their flight was leisurely and flaunting, so that they were always readily distinguishable. Their mimic, the *Elymnias*, flew more rapidly, but even then attracted one's attention as being remarkably similar to its models. By the time one had realized the true nature of the insect, it had flown past and a critical moment was gone. If the butterfly was followed up, it would be seen to settle on some twig or stalk with the wings closed, but on coming up to close quarters one might search for it in vain; any sudden movement would cause it to dart away, displaying once again its Danaine coloration, to some other resting-place, and so the hunt would be continued *ad nauseam*.

Elymnias godferyi (Dist.) mimics *Delias aglaia* (Linn.), and has on the under side some appropriate yellow and red markings, which are, however, somewhat obscured by mottlings of brown. We have here, in fact, a species which is beginning to discard a uniform mottled under side in favour of brighter mimetic coloration, such as is seen in some species from New Guinea and the neighbouring islands, which mimic very closely on both surfaces of the wings Euplœine and Pierine butterflies, and have discarded entirely a protective coloration.

Elymnias aroa, sp. n., is described in Appendix I. to this paper: only two specimens were captured. It is a fairly good mimic of *Tronga crameri* (Lucas), which occurred with it.

The common day-flying moths the Agaristid *Scrobigera hesperioides* (Wlk.) and the Chalcosid *Eterusia obliquiaria* (Wlk.) are

closely similar in wing pattern and colour (compare figs. 7 & 8, Plate XXI.); their coloration recalls that of *Heliconius clysonymus* (Latr.) and *H. ricini* (L.) of S. America and of the common Oriental *Cethosia hypsea*.

[The majority of the Chalcosid synaposemes named in Table IV. are shown on Plate XXI., together with their Euplœine, Pierine, and Agaristid models. The resemblance to the *Pierinæ* is so much more striking and the patterns so much more detailed and varied on the under sides of the wings, that this aspect is alone represented in the case of both Pierine models and their Müllerian mimics (figs. 1 to 6, Plate XXI.). *Delias cathara* (Grose-Smith) is very rare, whilst its mimic *Callamesia pieridoides* (Wlk.) (compare figs. 5 & 6) is comparatively common, a fact which supports the Müllerian interpretation. A comparison of the whole series of Chalcosid mimics and their models leaves no doubt that the moth is the mimic and the butterfly the model, even though the former be common and the latter rare.—E. B. P.]

The species of *Symbrenthia* and of *Athyma* have a close resemblance to the Neptides, all of which are highly distasteful. The association in this case is probably Müllerian.

The extremely common Lycænidæ *Eoxylides tharis*, *Drupadia boisduvalii*, and *Biduanda thesmia* are mimicked by *Thrix gama*, by *Araotes lapithis*, and by *Poritia plateni*. In this case the mimicry is Batesian. Mr. de Nicéville, in his 'Butterflies of India,' vol. iii. p. 11, gives a list of mimetic Lycænidæ compiled by Doherty, but he informs me that Doherty conducted no experiments to prove the correctness of his association of the various species in mimetic examples. I am, however, quite certain that *E. tharis*, *D. boisduvalii*, and *B. thesmia* are distasteful species, whilst the great rarity of the mimicking species points to the conclusion that they are Batesian mimics.

V. DIPTERA AS MIMICS.

A complete list of the mimetic flies of Borneo would comprise at least one-third of the total number of species, but inasmuch as the literature on the Malayan Diptera and their Hymenopterous models is both scanty and scattered, I think it advisable to postpone the compilation and discussion of such a list until our knowledge of these two orders as represented in the East is increased and more systematized. I therefore select for special notice and description eight species only, each of which exhibits some noteworthy modifications of structure and habit, produced in the attainment of a likeness to its respective mimic.

i. **Mimic.** *Laphria* sp. near *terminalis* (v. d. Wulp). Plate XXII. fig. 10.

Model. *Salius sericosoma* (Smith). Plate XXII. fig. 9.

This large and handsome fly is not infrequently met with in the neighbourhood of Kuching, and the immunity which it

enjoys is doubtless due to the closeness of its resemblance to an equally conspicuous *Salius*, an ally of which has already been noted as the model of a Longicorn beetle. The fore wing of the *Laphria* is large, almost as broad as both fore and hind wing together of the *Salius* and of the same clear golden-brown. The thorax, as in the wasp, is covered dorsally with a golden pubescence, whilst the abdomen, like that of the model, is black, and terminates in a sharp tufted point very suggestive of a sting. All the tibiæ and tarsi are ochreous, but the black and thickened femora are very unlike those of the *Salius*. No attempt at mimicking the long ochreous antennæ of the wasp is made, as in some other Diptera shortly to be described (compare figs. 9 & 10, Plate XXII.). The buzzing, noisy flight of this fly is very like that of its model.

[In the natural attitude of rest it is probable that the black femora of the fly are held upright and near to the body, so that the ochreous parts of the legs would alone be conspicuous. It is noteworthy that the *under sides* of the anterior femora are ochreous, suggesting that the anterior limbs may in certain attitudes be raised, or, at any rate, that they are held so that this part is more conspicuous than any other femoral surface. It is probable that this special colouring is directed to meet a view from the front. It is to be hoped that future observations will be specially directed to these points. This fly belongs to the family of the Asilidæ (subfamily *Laphrinæ*), the most formidable and predaceous of Diptera, and it is quite possible that the resemblance to a wasp is Mullerian (synaposematic) rather than Batesian (pseudaposematic).—E. B. P.]

ii. **Mimic.** *Hyperechia fera* (v. d. Wulp). Plate XXII. fig. 2.
Model. *Xylocopa latipes* (Drury). Plate XXII. fig. 1.

No more remarkable proof of the plasticity of the Dipterous form could be advanced than this remarkable insect. The large, clumsy *Xylocopa*, with its bronzy wings and thick furry legs, would seem to be an eminently unsuitable and difficult model to copy; and it would be most instructive, if only it were possible, to trace the steps by which this fly has arrived at what at first sight appears to be the pitch of mimetic perfection. As a matter of fact the fly is extremely rare, and one can only conclude that the mimicry, exact though it seems, has failed to preserve the species as a dominant one.

The head is characteristically Dipterous; the thorax is of shining blue-black, clothed with a fine dense pubescence, coarser and longer on the sides; the broad, flattened abdomen is laterally bordered with a fringe of long hairs exactly as is the case with the *Xylocopa*, and terminates in a fine tufted process suggesting a sting. As in *X. latipes*, all the legs are remarkably hairy and sturdy, particularly the last pair, and are of much the same length. The wings are of a bluish-bronze hue: the downwardly-

curved submedian vein in the wing of the fly represents the junction between the fore and hind wings of the bee, and the areolet of the hind-wing of the bee also finds its parallel in the alula of the fly. The halteres are quite concealed amongst the hairs on the sides of the thorax. I have only seen one solitary specimen of this fly (Kuching, Feb. 1899), and have nothing to record of its habits beyond stating that both on the wing and at rest it was exceedingly difficult to distinguish from the common *X. latipes* (compare figs. 1 & 2, Plate XXII.).

[It is possible that the fly is constantly mistaken for a Xylocopid, and that it is not nearly so rare as it appears to be. The genus is widespread, and Mr. G. A. K. Marshall has sent me an equally beautiful example from Mashonaland. In this case the insect is unique (it has been recently described as *Hyperechia marshalli* (Austen)), but Mr. Marshall's notes clearly indicate the reason of its rarity. It must be remembered also that the extreme perfection of the resemblance is aided by the rapid flight and alertness of the fly. *Hyperechia* belongs to the same family and subfamily as the species last described, and here, too, the Müllerian interpretation must be taken into account. In fact Mr. Roland Trimen, to whom I showed the African specimen, expressed the opinion, from his experience of its allies, that it is a far more formidable insect than its model. The strengthening and curvature of the submedian vein in the fly's wing, which apparently represents the junction between the bee's fore and hind wings, is an instance of the attainment of a detail in the resemblance by a very slight alteration of form; for the vein in the last-described species of fly pursues nearly the same curved direction, although the line of junction of the wings of its model is nearly straight. In both species of fly there is a slight break in the even contour of the margin at the point where this vein reaches it, which is very suggestive of a junction between fore and hind wings, while the curve of the margin is changed on either side of the break in such a manner as further to promote the resemblance.—E. B. P.]

iii. **Mimic.** *Milesia vespoides* (Wlk.). Plate XXII. fig. 14.
Model. *Vespa cincta* (Fab.). Plate XXII. fig. 13.

The large wasp, black with a broad red band on the second abdominal segment, is closely mimicked by an equally large fly with the distal half of the second segment and the proximal half of the third segment coloured red. This red band, though actually occupying a different position from that of the wasp, is separated from the thorax by a black interspace nearly equal in breadth to the wasp's first abdominal segment, which is also black. The wings are similarly coloured in both species (compare figs. 13 & 14, Plate XXII.).

iv. **Mimic.** *Midas*, n. sp. (Fam. Midaidæ.) Plate XXII. fig. 12.
Model. *Macromeris violacea* (Lep.). Plate XXII. fig. 11.

Macromeris violacea, a dark blue fossorial wasp, with dark blue

wings resplendent with metallic blue sheen, occurs commonly on the mountains near Kuching. On Mt. Santubong a fly was recently captured affording a close resemblance to the wasp. The body and legs are exactly of the same shade of colour as are those of the wasp; the wings, though somewhat browner, are more opaque and possess a blue metallic sheen sufficiently deceptive. Their size is large (larger than the fore wing alone of the wasp), and it is interesting to note the same downward curve of the submedian vein as was found in *Hyperechia fera*, suggesting the line of junction between a fore and a hind wing. The antennæ are fairly long, though far shorter than those of the wasp. I have not seen this species in the living state, but even as a cabinet specimen it is a remarkable case of deceptive resemblance (compare figs. 11 & 12, Plate XXII.).

Specimens of this fly from the Philippines and Tenasserim are in the British Museum collection of Diptera.

v. **Mimic.** *Physocephala* sp. (Fam. Conopidæ.)
Model. *Ischnogaster micans* (Sauss.).

This example has been selected at hazard from a large number of similar thin-waisted flies, chiefly Syrphidæ and Conopidæ, as typical of the method by which the similarly built Eumenidæ and Vespidæ are mimicked. The first abdominal segment is much attenuated and drawn out, those following are thickened; the transparent wings are shaded with fuscous on their anterior borders, in accordance with a similar arrangement in the wasp; the head is the only part which exhibits any of the yellow colouring of the model.

vi. **Mimic.** Gen. et sp.? (Fam. Stratiomyidæ, subfam. *Raphiocerinæ*.) Plate XXII. fig. 6.
Model. *Mesostenus* sp. near *pictus* (Smith). Plate XXII. fig. 5.

Both species were taken on Mt. Penrissen on the same day, and the similarity of their external appearance was equalled by the similarity of their method of flight and action when at rest. The Ichneumon-fly was common enough, and was frequently seen to hover over a plant for a few minutes, then suddenly drop down and pitch on to a leaf, over which it would walk, moving its white-banded antennæ up and down with a quick flickering movement. The fly, of which only one specimen was caught, behaved in exactly the same manner; it would hover, then suddenly settle and walk over a leaf on its mid and hind pairs of legs, waving rapidly up and down its long front legs, the tibiæ of which being black and the tarsi white, most closely resembled the antennæ of the Ichneumon-fly. The femora were kept more or less pressed against the ventral surface of the head, so that the sham antennæ seemed actually to arise from the correct position. This method of bringing about a resemblance to long antennæ is

also made use of by several species of *Calobata* and allied genera, but in the case here described the mimicry of an Ichneumon-fly is carried still further, inasmuch as the coloration is almost identical in both species, viz., black with yellow spots on the head and thorax, with alternate yellow bands on the abdomen, while the legs are ochreous with a black band at the apex of the femora and tibiæ. Furthermore, the ample clear wings are very similar in both mimic and model (compare figs. 5 & 6, Plate XXII.). The nearest allies of this remarkable fly occur in S. America.

vii. **Mimic.** ? *Xylophagus* sp. (Fam. Leptidæ.) Plate XXII. fig. 8.
Model. *Mesostenus* sp. Plate XXII. fig. 7.

This example is remarkable for the great elongation of the antennæ of the fly. In the previous case it was seen that the long antennæ of the model were represented by the fore legs of the mimic, but here there is an actual copy produced by means of a very unusual modification amongst the Diptera. The mimicry is so perfect that it will almost bear a close scrutiny through a lens; the large eyes, prominent clypeus, and maxillary palps of the fly give the head, even when thus closely examined, a characteristic Hymenopterous appearance. For the rest, the coloration is almost identical in both species: black with yellow spots and bands (compare figs. 7 & 8, Plate XXII.). The larva of the fly was found in decayed wood and presented no very extraordinary features.

viii. **Mimic.** *Sepedon* sp. near *javanicus* (Desv.). (Fam. Sciomyzidæ.) Plate XXII. fig. 4.
Model. *Collyris emarginata* (Macl.). Plate XXII. fig. 3.

It is not usual to find amongst the Diptera species which mimic any other order of insects than the Hymenoptera. This example and a species of *Celyphus*, which only very doubtfully can be considered as mimicking a small bug, are the only cases known to me.

Both of the species now under discussion were caught together on the wing on Mt. Serambu, Sarawak, and when seen alive and actively moving about were not readily distinguishable. As cabinet specimens they furnish an instance of the importance of field-work in the study of mimicry, and of the unreliability of dead impaled insects or mere figures unless, indeed, both are prepared with reference to careful observations of the living forms. The fly when alive was of a very brilliant blue like that of the *Collyris*, but the colour has now faded to a dusky indigo, while the abdomen being much shrunk detracts considerably from the previous resemblance. The legs are brilliant red, and constituted one of the most conspicuous features of both fly and beetle (compare figs. 3 & 4, Plate XXII.).

VI. RHYNCHOTA AS MIMICS.

α. Rhynchota Hemiptera.

i. **Mimic.** A *Reduviid*, sp.
Model. *Bracon*, sp.

The bug has the elytra, wings, and dorsal surface of the body reddish ochraceous as in certain common Braconidæ; the abdomen beneath is white; the apex of the coriaceous part of the elytra is black, thus resembling the black stigma on the fore wing of the model; while both elytra and wings are suffused with fuscous as in the model. So perfect is the resemblance between the two species that the bug was placed in a cabinet together with several other Hymenoptera, and the mistake was only discovered quite recently whilst attempting to arrange the museum collection of Braconidæ.

Another species, probably of the same genus of bug, mimics another similarly coloured species of *Bracon* in the same manner as above described.

[See also under section *Convergent Groups* for other examples of mimetic Hemiptera.]

β. Rhynchota Homoptera.

ii. **Mimic.** *Issus bruchoides* (Wlk.). Plate XIX. fig. 10.
Model. *Alcides*, sp. (Curculionidæ.) Plate XIX. fig. 9.

This remarkable little Homopteron, one example only of which is in the British Museum from Sumatra, occurs not uncommonly at Kuching on fallen logs or on living wood, whilst the Weevil is frequently found beneath the bark of fallen logs, sometimes in the very logs on the surface of which is found the mimic.

The whole appearance of the mimic with its hard convex elytra and deceptively powerful legs is very weevil-like, and the resemblance was evidently noted by the describer. The fore legs are much flattened and in side-view correspond closely in appearance to the powerful fore legs of the *Alcides* (compare figs. 9 & 10, Plate XIX.).

VII. SPIDERS[1] AS MIMICS.

i. **Mimic.** *Cyrtarachne conica* (O. Pickard-Cambridge).
Model. *A mollusc.*

The abdomen of this Spider is many times larger than the cephalothorax and is dorsally produced into a cone, which appears as if tilted backwards. The colour of the abdomen is creamy or yellowish white, marked with fine black and greenish lines and mottlings, arranged in a somewhat concentric manner so as to

[1] The Spiders here noted were described in P. Z. S. 1901, i. p. 11 *et seq.* pl. v. *Cyrtarachne conica* was wrongly recorded as occurring in Singapore.

represent very closely the whorls of a spirally coiled snail-shell, such as *Helix*.

The spider occurs in Kuching, and is generally found resting on leaves, sometimes with the cephalothorax turned right under the abdomen, in which position it is readily mistaken for a snail-shell, or with the cephalothorax in the normal position. In the latter case, if disturbed, this part of the body is immediately doubled under the abdomen and the animal usually rolls off the leaf, especially if a small one, and becomes lost in the decaying vegetation carpeting the ground below. I have been unable to discover any web, nor have I seen the manner in which the animal hunts or seizes its prey, but it seems probable that this is an example of one of those doubly significant devices whereby an animal is enabled not only to avoid its foes (in this case predatory wasps) but also to approach its own prey unobserved.

[It is possible that this resemblance is cryptic rather than mimetic. The former interpretation seems to be valid in the case of the British larva *Aspilates gilvaria*, which also resembles a snail-shell.—E. B. P.]

ii. **Mimic.** *Amycira lineatipes* (Pickard-Cambridge).
Model. *Œcophylla smaragdina* (Fab.).

I am indebted to Mr. H. N. Ridley for leave to incorporate in this paper the observations which he has made on this mimetic species, which as yet I have failed to find in Borneo. The ant under notice is an extremely common and ferocious species, chiefly remarkable for its nest-building habits. Mr. Ridley has described these habits in the Journal of the Asiatic Society, Straits Branch, 1890, No. 22, p. 345. The spider is of the same colour as the ant (reddish brown), and bears on the posterior part of the rather acutely pointed abdomen a pair of black eye-like spots, so that it is the abdomen of the spider which corresponds to the head, the cephalothorax to the abdomen of the ant. Both mimic and model are found together near the nest of the latter, and so close is the resemblance between the two that the spider is able to prey with impunity on the ants: I have taken a specimen of a spider with the body of an ant sucked nearly dry in its jaws; and Mr. Ridley has seen an individual pounce on an ant and then dropping from its foot-hold on a leaf, hang suspended by a silk thread in order to complete its meal in safety. No web is spun by the spider, but a round disc of silk, probably the egg-cocoon of this species, was found on the under surface of a leaf much frequented by the spider and its models.

iii. **Mimic.** *Salticus attenuatus* (Pickard-Cambridge).
Model. *An Ant.*

Mr. Ridley also sent me from Singapore a remarkable little Attid with a well-marked constriction about the middle of the

cephalothorax and a slender abdominal peduncle, so that the triple division of the insect-body is well imitated. The abdominal peduncle appears to bear a small scale and the abdomen is elongated; the elbowed antennæ of an ant are mimicked by the anterior pair of legs of the spider. I have not been informed whether this species, like the preceding, lives in company with its models.

VIII. CONVERGENT GROUPS.

There are certain combinations of colours in distasteful or otherwise specially protected insects which may be considered as warning: such are, black with yellow bands, black with one broad red band, black with white tips to the wings, yellow or red with black spots, red elytra or wings more or less broadly tipped with black; and we find insects, belonging to the most diverse orders, with one or other of these combinations of colours converging to a central form, a typical distasteful insect. Some of these converging forms may be non-immune and pseudaposematic (examples of Batesian mimicry); others may be distasteful themselves and synaposematic (examples of Müllerian mimicry). For example, all the Lycidæ are strongly distasteful, as I have proved by repeated experiments[1], and large numbers of them show the same type of coloration, the anterior third or two-thirds of the elytra being red, the posterior two-thirds or third black, whilst the head and thorax are black or red. Resembling the members of this group are ten species of Longicorns, belonging to four subfamilies, one Clerid, two Hispids, two Elaters, one Rhipidocerid, one Eucnemid, or seventeen Coleoptera in all, one moth and several Hemiptera. The Lycidæ, then, may be considered as distasteful insects which are characterized by a definite type of warning coloration, whilst the coloration of the insects which resemble them so closely can hardly be looked on as essentially typical of the groups to which the insects belong. The conspicuous Lycid, *Lycostomus gestroi* ♀, is mimicked by three Longicorns *Erythrus apiculatus* var., *E. rotundicollis* and *sternalis*, and by *Eurycephalus lundi*, by a moth, *Phauda limbata*, by at least four bugs, of which *Ectatops rubiaceus* and *Serinetha abdominalis* alone have been identified.

The arrangement of colours in the Lycid *Metriorrhynchus kirschi*, in the Longicorns *Ephies dilaticornis* and *Erythrus biapicatus*, in the Hispid *Gonophora wallacei* var., and in a Clerid of the genus *Tenerus* (*T. sulcipennis* (Gahan)) is almost identical. *Calochromus dispar* is mimicked by the Longicorns *Pyrestes eximius* and *P. virgata*, by a Rhipidocerid of the genus *Ennomates*, and by an unidentified Eucnemid. The Lycids *Ditoneces* sp. near *fuscicornis* and *Taphes brevicollis*, the Lamiid Longicorn *Nyaste torrida*,

[1] A strong vitality is correlated with this distastefulness; I have seen a Lycid beetle walk away apparently uninjured after it had been well pecked by two or three fowls. The distasteful Endomychidæ are also difficult to kill (*cf.* also vitality of *Danainæ*, *Acræinæ*, and *Heliconinæ* noted by various authors).

and the Hispid *Gonophora wallacei* are much alike in their general appearance; and so too are the Lycids *Cautires excellens* and *Metriorrhynchus acutangulus*, the Elaters *Agonischius pectoralis* and *A.* (?) *sanguineipennis*, the Longicorns *Xyaste fumosa* and *X. invida*, and a Reduviid bug.

The association of these species in one convergent group is represented in a diagrammatic way in Table V. (p. 269): the species other than Lycidæ which I consider to be distasteful are indicated by an asterisk, but it is not improbable that others may hereafter be proved to be Müllerian rather than Batesian mimics.

[The prevalent types of Lycid coloration are very simple, being uniform red or ochreous or one of these colours combined with black. The same patterns have an immense range corresponding with the wide distribution of the family over the warmer parts of the world. Hence this beautiful group of Bornean insects of many orders which adopt a colouring characteristic of the Lycidæ could no doubt be paralleled in many countries. Examples of Lycoid American moths belonging to distasteful groups are given in Journ. Linn. Soc. (Zool.) vol. xxvi. p. 569. Mr. G. A. K. Marshall has sent me a wonderful group belonging to this type, the ground-colour being ochreous, from Salisbury, Rhodesia. The central type is provided by seven species of Lycidæ, and it is resembled by a Telephorid, a Melyrid, two Phytophaga, three Cantharidæ, three Longicorns, many species of Hymenoptera Aculeata, several Hemiptera, a fly (*Xiphocerus*), a Zygænid moth, and an Arctiid Moth. This group is briefly mentioned in the Report of the British Association (Section D), Bradford Meeting, 1900, p. 793.- E. B. P.]

A second group may be formed out of Coccinellid-like insects. All the well-known Coccinellidæ with red or yellow elytra spotted with black are the central figures of the group, with perhaps an excessively common Cassid, *Prioptera octopunctata*; mimicking these are a Longicorn, *Entelopes glauca* (Pasc.), two species of *Lema* and a *Curculio*, the remarkable new Locustid of a genus near *Gammarotettix*, a Pentatomid bug of the subfam. *Asopinæ*, *Blachia ducalis* (Wlk.), and a spider with large red abdomen spotted with black. The association is indicated diagrammatically in Table VI. (p. 270); the mimics of Coccinellidæ, which are believed to be Müllerian, are indicated by asterisks. Nearly the whole of the species here mentioned are figured on Plate XXIII. figs. 30 to 36. The *Lema* figured (*L. quadripunctata*) is a less perfect mimic than *L. femorata*.

The little Dammar-bee *Melipona vidua* (Lep.), black with white-tipped wings, is an extremely common insect in Borneo, and, though stingless, is protected by its ferocious biting and social habits[1].

[1] A certain tree in the jungle near the Sarawak Museum was known to harbour a nest of this species; when the bees swarmed it was impossible to approach the tree without attracting a large number which settled on one's hair and face and bit so fiercely that a hasty retreat had to be made. A tame monkey, secured by a chain and sliding ring to a bamboo pole which contained a nest of another species of *Melipona*, refused after two attempts to scale the pole when the bees were swarming round the mouth of the nest.

TABLE V.

Convergent Group 1.

(Lycoid pattern.)

HEMIPTERA.
Serinetha abdominalis * and *Ectatops rubiaceus* * and others.

LEPIDOPTERA.
Phauda limbata. *

LYCIDÆ.

LYCOSTOMUS GESTROI.

COLEOPTERA.
Subfam. *Pyrestinæ.* *Erythrus rotundicollis.* *

Subfam. *Pyrestinæ.* *Erythrus apiculatus* * var.

Subfam. *Pyrestinæ.* *Erythrus sternalis.* *

Subfam. *Euryphaginæ.* *Eurycephalus lundi.* *

COLEOPTERA.
Fam. *Eucnemidæ.* Genus & sp.?

COLEOPTERA.
Fam. *Rhipidoceridæ.* *Ennomates* sp.

CALOCHROMUS DISPAR.

Subfam. *Pyrestinæ.* *Pyrestes eximius* and *P. virgata.*

COLEOPTERA.
Fam. *Cleridæ* *Tenerus sulcipennis.* *

METRIORRHYNCHUS KIRSCHI

Subfam. *Pyrestinæ.* *Erythrus biapicatus.* *

COLEOPTERA.
Fam. *Hispidæ.* *Gonophora wallacei,* var. *

Subfam. *Lepturinæ.* *Ephies dilaticornis.*

HEMIPTERA.
Reduviid. *

CAUTIRES EXCELLENS and METRIORRHYNCHUS ACUTANGULUS.

Subfam. *Saperdinæ.* *Xyaste fumosa* and *X. invida.*

COLEOPTERA.
Fam. *Elateridæ.* *Agonischius ? sanguineipennis.*

COLEOPTERA.
Fam. *Elateridæ.* *Agonischius pectoralis.*

DITONECES sp. near FUSCICORNIS and TAPHES BREVICOLLIS.

Subfam. *Saperdinæ.* *Xyaste torrida.*

COLEOPTERA.
Fam. *Hispidæ.* *Gonophora wallacei.* *

COLEOPTERA—LONGICORNIA.

The species mentioned in this table are figured, almost without exception, on Plate XXIII. figs. 1 to 29.

TABLE VI.

Convergent Group 2.

(Coccinellid pattern.)

ARACHNIDA.
Genus
&
sp ?

ORTHOPTERA.
Genus
near
Gammarotettix.

COLEOPTERA.
Fam.
COCCINELLIDÆ,
e. g. CARIA
DILATATA.

HEMIPTERA.
Blachia
ducalis *.

Longicornia.
Entelopes
glauca.

Phytophaga.
Lema
femorata *
and
L. quadripunctata *.

Cassidæ.
Prioptera-
8-*punctata* *.

Curculionidæ.
Apoderus
javanicus.

COLEOPTERA.

There are two species of *Protoanthidium* coloured in the same way; and there is a large concourse of insects of different orders mimicking this type of coloration, viz.: four Hymenoptera; three species of *Bracon*, one with very hairy hind femora and tibiæ simulating the dilated tibiæ of its model, and a Chalcid, *Megalocolus notator* (Walk.); a Longicorn, *Epania singaporensis* (Pasc.); a plume moth; a Capsid, a Reduviid, and an obscure Homopterous insect; two flies, *Holocephala* near *hirsuta* (v. d. Wulp), and *Toxophora* near *javana* (Wied.). The resemblances between these mimics and the *Melipona* are in some cases remarkably exact; the Longicorn and the *Holocephala* were taken in the company of the bees; all the mimicking Hymenoptera are indistinguishable from their model whilst on the wing. In this group I consider the *Melipona* to be the central typical warningly coloured and specially protected insect. Asterisks indicate the convergent species which are probably synaposematic in the following diagrammatic arrangement represented in Table VII. (p. 271). The whole of the species are shown in Plate XXIII. figs. 37 to 47.

Table VII.

Convergent Group 3.

(*Melipona*-like pattern.)

HYMENOPTERA.

Bracon sp. *

Megalocolus notator *.

Bracon sp. *

Toxophora sp. near *javana*.

DIPTERA.

Holocephala sp. near *hirsuta*.

COLEOPTERA.
Epania singaporensis.

HYMENOPTERA
MELIPONA-VIDUA
and two
species of
PROTOANTHIDIUM.

LEPIDOPTERA
Plume-moth.

Red Coreid *.

Homoptera Genus nr. *Brixia*.

Capsid *.

HEMIPTERA.

A fourth group is characterized by the following combination of colours: black head, red thorax, and iridescent green elytra. This type of coloration is well illustrated by a Melyrid, *Prionocerus cœruleipennis* (Perty), a Longicorn, *Erythrus viridipennis* (Gahan), an Erotylid, a Hispid, *Botryonopa cyanipennis* (Baly), and a Clerid. It is probable that the whole of these species are synaposematic, as is indicated in the accompanying Table VIII. Group 4 (p. 272). Four of the species are represented on Plate XXIII. figs. 58 to 61.

A fifth group has a broad red band across the middle of the abdomen; into this will fall two common wasps, *Vespa cincta* and *Polistes sagittarius*, and their mimics, a Sesiid moth, a fly, and a Mantispa. There is at present no reason for considering any of the convergent species shown in Table VIII. Group 5 as other than pseudaposematic. The *Mantispa* and *Polistes* are shown in figs. 27 & 26 on Plate XIX., the *Vespa* and *Milesia* on figs. 13 & 14 on Plate XXII.

TABLE VIII.

Convergent Group 4.

(Probably modified Lycoid pattern.)

Longicornia.
Erythrus viridipennis. *

Fam. *Hispidæ.*
Botryonopa cyanipennis *.

Fam. MELYRIDÆ.
PRIONOCERUS COERULEIPENNIS.

Fam. *Cleridæ*,
gen. et sp.? *

Fam. *Erotylidæ.*
Tetralanguria pyramidata. *

Convergent Group 5.

(Red-girdled aculeate pattern.)

DIPTERA.
Milesia vespoides.

LEPIDOPTERA.
Sesia sp.

VESPA CINCTA.
POLISTES SAGITTARIUS.

NEUROPTERA.
Mantispa sp.

There is a considerable assemblage of uniformly-coloured ochreous species of Phytophaga of the families Halticidæ, Galerucidæ, etc., and of mimicking Longicorns of the subfamilies *Saperdinæ* and *Astatheinæ*; these, however, are not included in the table, as sufficient examples have been given clearly to illustrate the wide distribution of a characteristic type of warning coloration.

APPENDIX I.

1. LEPIDOPTERA RHOPALOCERA, by R. SHELFORD.

ELYMNIAS AROA, sp. n.

♂. Dark fuscous brown, with the following cream-white markings:—*Upper side*: *fore wing*, a submarginal series of spots commencing from below the discoidal nervule, the last one double; some indistinct notching at the external angle; the external margin is somewhat irregularly scalloped: *hind wing*, a sub-discal series of internervular spots and dashes, one of each to each interspace, the last interspace but one carrying a double

set, the last a single streak; a series of large submarginal spots, the last of which fuses with the above-mentioned streak, the others partially or completely distinct; some marginal irregular mottlings. Wing rather deeply scalloped and subcaudate. *Under side* pale fuscous; *fore wing*, costal area black barred with white, some basal white mottlings, submarginal spots more distinct than on the upper side; *hind wing*, some basal white spots, one below the first subcostal nervule, another just below the cell, the subdiscal series very indistinct, the submarginal series of large spots distinct, a marginal mottled band of transverse streaks far more pronounced than on the upper side, inner margin blackish barred with white. Cilia white and fuscous alternately. Expanse 80 mm.

♀. *Upper side* paler fuscous, markings as in the male; *under side* as in the male but the markings more diffuse. Expanse 93 mm.

Hab. Mt. Penrissen, Sarawak.

Types in the Sarawak Museum.

The nearest ally of the species appears to be *E. lutescens* (Butl.).

2. Coleoptera Longicornia, by C. J. Gahan.

Zelota, gen. nov. (*Mesosinarum*).

Head deeply concave between the divergent antenniferous tubers; front slightly convex, narrowed between the eyes; genæ long and somewhat swollen; eyes divided, rather finely facetted. Antennæ of the male scarcely longer than the body; scape stout, subclavate, furnished at its apex with a short spine behind and a narrow cicatrix in front, the latter completely bounded by a projecting rim; third joint slender, slightly curved, nearly twice as long as the first or fourth, armed at the apex with a sharp spine; 5th to 11th joints very short, together scarcely longer than the 4th; last five or six joints thickly fringed with long hairs underneath, the remaining joints being sparsely ciliate. Prothorax transverse, rounded and unarmed at the sides. Mesonotum without stridulating area, arcuately emarginate in front. Elytra but little longer than their conjoined width, prominent at the shoulders, broadly rounded at the apex; each furnished a little behind the base with a very prominent ridge, surmounted by a tuft of long hairs tapering to a point in imitation of a spine. Prosternum strongly arched, almost vertically sloped behind. Mesosternum short and horizontal behind, subvertical in front. Legs subequal in length; femora fusiform; middle tibiæ without notch on outer margin; claws of tarsi divergent.

This new genus comes near *Cacia* (Pasc.) in the group or subfamily *Mesosinæ*; and in the same section with it should be placed the genera *Planodes* (Newm.) and *Calymmophis* (Thoms.), which Lacordaire, on insufficient grounds, withdrew from the *Mesosinæ*, assigning them a place in his "groupe" *Monohammides*. The genus *Ereis* (Pasc.), which was treated by him in the same way, should also be restored to the *Mesosinæ*, finding a place near the genus *Mesosa*.

ZELOTA SPATHOMELINA, sp. n. (Plate XXIII. fig. 57.)

Nigro-cyanea; capite fere nigro, in fronte subnitido, utrinque pone oculum inferiorem macula rufo-fulvescente notato; prothorace transverso, lateraliter rotundato, antice transversim sulcato, tenuissime griseo-pubescente; elytris sat dense punctulatis, nigro-cyaneis aut violaceis, utrisque maculis duabus aut tribus rufo-fulvis notatis una communi paullo pone scutellum, secunda ad marginem externam paullo pone basin, tertia fere ad medium disci; pedibus nigro-cyaneis aut violaceis, sparse ciliatis; tibiis extus in medio albo-cinereis.

Long. 7–8; *lat.* $3\frac{1}{2}$–4 *mm.*

Hab. Sarawak. 1 ♂ in Brit. Mus., 2 ♂♂ from Kuching, Sarawak (*R. Shelford*), in the Hope Museum, Oxford.

In the two ♂ specimens in the Hope Museum there is a small spot of reddish pubescence just under the anterior part of the lower lobe of each eye, in addition to the somewhat larger rounded spot of the same kind behind the lobe. In these specimens also the third reddish spot of each elytron -- that placed a short distance behind the base of the large tufted tubercle, but a little more externally—is present and distinct, and there is a cinereous patch crossing the elytra a little in front of the apex.

APPENDIX II.

Descriptions of additional Species mentioned and figured in the accompanying paper.

[Received January 5, 1903.]

1. LEPIDOPTERA HETEROCERA, by KARL JORDAN.

MIMEUPLŒA TRISTIS, sp. n. (Plate XXI. fig. 12, ♀.)

♂. Body olive-black, with a rather feeble greenish-blue gloss; under side white-spotted as in *M. rhadamantha*. Wings mummy-brown above and below, not distinctly metallic, except costal margin of fore wing below and a small dot at base of fore wing above. Fore wing, upper side: a series of broad creamy-white streaks from costal margin to SM^2, separated by the brown veins, the upper ones reaching from margin halfway to cell, the posterior ones shorter and not quite touching margin. A series of streaks also on hind wing, but here thin, submarginal. The streaks present on under side of both wings, broader than above, all reaching margin.

♀. Similar to ♂; streaks of fore wing vestigial and narrow above, the five posterior ones ending proximally in a small white spot, streak M^1–M^2 much longer than the two above and the one below it; streaks of under side of fore wing broader than above, but thinner than in male and much more clayish. No streaks on hind wing above, but vestiges of them present on underside. (Neuration of this specimen abnormal on right fore wing.)

Length of fore wing: ♂ 32, ♀ 36 mm.

Hab. North Borneo: ♂ from Sandakan, June 28, 1894 (D. Cator, in the Tring Museum); ♀ from Kuching, Oct. 1895 (Sarawak Museum, Kuching).

Neuration similar to that of *M. rhadamantha.*

2. Coleoptera Longicornia, by C. J. Gahan.

Erythrus rotundicollis, sp. n. (Plate XXIII. fig. 6, ♂.)

Niger, elytris a basi usque paullo pone medium rufis: antennis quam corpore a quarta parte brevioribus, articulis 5° ad 10um ad apicem antice dentatis; prothorace lateraliter rotundato, latitudine maximo ad medium, disco tuberculis duobus parvis nigro-pilosis vix ante medium positis instructo; elytris postice rotundatim attenuatis, utrisque ad suturam breviter dentatis.

Long. 17; *lat.* 4 *mm.*

Hab. Mt. Santubong, 2600 ft., February 4, 1900. One male specimen.

Black, with rather more than the basal half of the elytra red. Antennæ about three-fourths the length of the body, with the joints from the fifth to the tenth produced into a tooth at the antero-distal angle. Prothorax rather strongly rounded at the sides and widest about the middle; the disk with two small velvety tubercles placed barely in front of the middle. Elytra slightly widening from the base up to about the posterior third or fourth, and thence narrowing towards the apex, where each ends in a small sutural spine; the disk of each with a rather feeble costa extending from the base to a little beyond the middle.

This species most resembles *E. atricollis* Pasc., but in the latter the dark apical area of the elytra is less extensive; the prothorax is less rounded, is widest behind the middle, and on the disk has but a single median cariniform tubercle.

Erythrus sternalis, sp. n. (Plate XXIII. fig. 7, ♂.)

Niger, elytris a basi usque pone medium rufis: prothoracis disco tuberculo mediano inter medium basinque, et utrinque tuberculo parvo paullo ante basin posito, instructo; elytris postice rotundatim attenuatis, utrisque ad suturam sat valde spinosis; prosterno inter coxas tuberculato, mesosterno postice minus fortiter tuberculato.

Long. 20; *lat.* 4½ *mm.*

Hab. Mt. Matang, 3600 ft., June 1900. Two male specimens; in British Museum and Hope Collection, Oxford.

Black, with basal three-fifths of the elytra red. Antennæ about three-fourths the length of the body; fifth joint angulate, each of the succeeding joints up to the tenth strongly toothed in front at the apex. Prothorax strongly and thickly punctured, with a median cariniform tubercle between the middle and the base, and a small blunt tubercle on each side of the disk nearer to the base. Elytra rather strongly punctured; the disk of each with a well-marked costa reaching from the base to within about

one-fifth from the apex. Prosternum rather strongly tuberculate between the coxæ; the mesosternum with a smaller tubercle on its hinder half.

This is the only species of the genus known to me in which the sternal processes are distinctly tuberculate.

Erythrus biapicatus, sp. n. (Plate XXIII. fig. 19, ♀.)

Niger, prothoracis disco et elytrorum basi rufis, nigro-vittatis: prothorace ruguloso-punctato, sine tuberculis distinctis; elytris dense granulatis, postice divaricatis, utrisque in spinam parvam terminantibus.

Long. 15½; *lat.* 3½ *mm.*

Hab. Kuching, Mt. Matang, 3600 ft., June 1900. One female example.

Black, with the disk of the prothorax and the basal third of the elytra partly red, the red of the prothorax being interrupted by two black bands extending from the front margin, and by a small median spot near the base, while the red on the base of the elytra is divided by a narrow band along the suture, and two wider bands on each side extending forwards and gradually narrowing from the posterior black area. Prothorax rugulose punctate, and showing traces only of the tubercles present in most of the other species. Elytra very densely granulate, the granules bearing very minute black setæ, which are scarcely evident except on the rufous areas near the base. Metasternum somewhat similarly granulate to the elytra, and the abdomen much more finely so. Antennæ of the female about half the length of the body, with the joints from the fifth to the tenth rather broad, and angulate at the apex on the anterior side.

The divergence of the elytra from the suture behind and the granulation of their surface serve to distinguish this species from all those hitherto described belonging to the genus.

Erythrus viridipennis, sp. n. (Plate XXIII. fig. 58.)

Niger, prothorace toto rufo, elytris viridescentibus aut viridi-cyaneis et opacis, antennis (♂) quam corpore paullo brevioribus, (♀) medium elytrorum vix superantibus, articulis 5° ad 10^{um} modice dilatatis ad apicem dentatis; prothorace obsolete punctato, supra leviter quadri-nodoso; elytris creberrime ruguloso-punctatis, apice subsinuatis ad suturam breviter spinosis.

Long. 12–16; *lat.* 2½–3 *mm.*

Hab. Mount Matang, near Kuching in Sarawak (3600 ft. alt.), June 1900. Five examples; in the British Museum and Hope Collection, Oxford.

Prothorax red above and below, elytra of a dull green or bluish-green colour, all the rest of the body together with the legs and antennæ being black. Prothorax indistinctly punctured, furnished with four feeble nodules on the disk, two being near the middle and two, more widely separated from each other, near

the base. Elytra very closely rugulose-punctate, gradually widening from the base backwards, broadly rounded and slightly sinuate at the apex, with a short spine on each at the suture.

NOTHOPEUS INTERMEDIUS, sp. n. (Plate XIX. fig. 21, ♂.)

Corpore supra, capite toto, pedibus antennisque fulvis, his versus apicem infuscatis; thorace subtus et abdomine nigro-cyaneis, sed prosterno mesosternoque medio, maculis duabus metasterni et segmento primo abdominis fulvis, hoc argenteo-sericeo; elytris (quod attinet ad hoc genus) perelongatis, apicem abdominis fere attingentibus.

Long. 27; *lat. (pone humeros)* 7 *mm.*

Hab. Sarawak, Mt. Penrissen, May 1899. One male example; in the Sarawak Museum, Kuching.

Head, antennæ (except the last four joints, which are brownish), disk of prothorax, and elytra tawny red; body underneath bluish black, but with the prosternum, mesosternum, a spot on each side of the metasternum, and the whole of the first abdominal segment tawny, the latter being covered with a silky pubescence giving silvery reflexions in certain lights. The elytra, though unusually long for this genus, extending nearly to the apex of the abdomen, are considerably narrowed from a little behind the shoulders, and each in its posterior half is scarcely half as broad as it is at the base. The hind tibiæ of the male are thickened and subcylindrical, narrowed towards the base and very slightly also towards the distal end.

This species comes nearest in structural characters to *Aphrodisium tibiale* Rits., from Assam, but differs from it in having the elytra still more attenuated behind and the front of the head narrower. Ritsema placed his species in *Aphrodisium* as an aberrant member of that genus; but considering the reduction in the size of the elytra and the peculiar form of the male hind tibiæ, I believe it to be better placed in *Nothopeus*, though undoubtedly showing strong affinities with *Aphrodisium*. His species and the one here described are both extremely interesting as showing the gradual progress of that modification leading to the very shortened elytra and the strongly mimetic forms characteristic of the genus *Nothopeus*.

PSEBENA, gen. nov.

Head short, as broad as the prothorax; eyes finely facetted, deeply emarginate, with the lower lobes rounded, the upper very narrow; palpi short and slender. Antennæ (♀) a little longer than the body, slender, filiform; 3rd, 4th, and 5th joints subequal to one another, each twice as long as the 1st; 6th distinctly shorter than the 5th; the succeeding joints gradually diminishing in length. Prothorax subcylindrical, as broad as it is long. Elytra short, squamiform, not reaching beyond the apex of the first abdominal sternite. Prosternum narrowed behind; front coxæ prominent, their acetabula angulate outwards and

open behind. Mesosternum much broader than the prosternum; acetabula of middle coxæ open to the epimera. Metathoracic episterna rather broad in front, narrowed behind. Femora pedunculate at base, gradually thickened into a fusiform club towards the distal end. Hind legs much longer than either of the anterior pairs; first joint of hind tarsi longer than the three succeeding joints together. Abdomen normal, its intercoxal process rather broad, and obtuse in front.

This genus, which I was at first inclined to refer to Lacordaire's group *Psebiinæ*, seems to me, on fuller consideration of its characters, to be better placed in the *Necydalinæ*, although it differs from other members of this group in having no anterior prolongation of the head, the front from the interantennary ridge to the clypeal suture being relatively very short, and the clypeus scarcely broader than the labium. The *Psebiinæ* have certain characters, wanting to the present genus, which point to an affinity with the *Auxesinæ* and *Methiinæ*, and, through those groups, with the *Œminæ*.

PSEBENA BREVIPENNIS, sp. n. (Plate XIX. fig. 12, ♀.)

Capite, prothorace, elytris ad basin, articulo primo antennarum et pedibus quatuor anterioribus rufo-testaceis; metasterno medio testaceo, lateraliter fusco; abdomine medio et pedunculis femorum posticorum pallide testaceis; ceteris nigro-fuscis aut nigris.

Long. 13–16 *mm.*

Hab. Kuching in Sarawak, Sept. 29 and Dec. 4, 1899. Two female examples; in British Museum and Hope Collection, Oxford.

Head, prothorax, first joint of the antennæ, the four anterior legs, and the base of the elytra testaceous red. Metasternum testaceous in the middle, dark brown at the sides. Abdomen pale testaceous along the ventral surface from the base to the last segment, this segment and the lateral borders being, like the upper side, brownish black. Hind legs also black, with the femoral stalks pale testaceous or nearly white. The head and prothorax are covered with a very faint reddish pubescence, but the prothorax has two slightly raised areas on each side bare of pubescence. The inner portion of each elytron near the base is very closely punctulate and covered with a faint pubescence, the outer and apical parts being sparsely punctulate and more glossy.

3. COLEOPTERA: *Cleridæ*, by the Rev. H. S. GORHAM and C. J. GAHAN.

CALLIMERUS CATENATUS (Gorham). (Plate XXIII. fig. 54.)

Nigro-subcæruleus, squamis albis ornatus; capite creberrime subtiliter, prothorace elytrisque parce distincte punctatis; prothorace nitido, oblongo, lateribus parum ampliatis, utrinque uni-impressis, cum marginibus anticis et posticis albo-squamosis; elytris opacis, apicibus oblique truncatis, lunulis

duabus in singulo, externe apertis, albis ; pectore albo ; ore, antennis, palpis pedibusque testaceis.

Long. 9 *mm.*

Mas? *Tibiis posticis juxta apicem denticulo acuto externe munitis.*

Hab. N.W. Borneo, Kuching.

Allied to and somewhat resembling *C. mirabilis* Gorh. Narrow, elongate, and rather smaller than the unique type of that species; clothed (including the legs) with very fine hairs. The white markings are (as in other species of this genus) composed of snow-white scales. The pattern is different from that of *C. mirabilis* in that there are on each elytron but two white lunules unconnected; each pair form an oblong X, but are scarcely joined at the suture. The apex is truncate, as in *C. mirabilis*.

A single example, apparently a male, collected Oct. 6, 1899.

Tenerus sulcipennis (Gahan).

Niger ; prothorace lateraliter nigro-viridescente, dimidio basali elytrorum et plaga sub-semicirculare ad basin pronoti pube rufo-velutina obtectis, dimidio apicali elytrorum atro-pubescente. Antennis articulis 3^o *ad* 10^{um} *antice valde dilatatis, articulo* 3^o *quam* 4^o *paullo angustiore ; pronoto ad medium basis paullo gibboso ; elytris utrisque quadri-sulcatis, interstitiis sat latis, leviter convexis.*

Long. 11 ; *lat.* $2\frac{3}{4}$ *mm.*

Hab. Kuching (March 1900). Two examples; in British Museum and Hope Collection, Oxford.

This species seems nearest allied to *T. cingalensis* White and *T. parryanus* Gorh., but differs from these and from all other known species of the genus in having the third joint of the antennæ almost as strongly dilated as the fourth, and the elytra impressed with longitudinal grooves.

4. Coleoptera: Rhynchophora, *Brenthidæ*, by Dr. A. Senna.

Diurus shelfordi Senna. (Plate XX. fig. 6, ♀.)

Moderately elongate, stoutish, black, provided with whitish scales of differing size sunk in the punctures; the head and the metarostrum with punctiform close-set scales, the joints of the antennæ clothed with long accumbent scales.

♂. Head slightly longer than broad, with the sides almost straight and a fovea between the eyes, which are prominent; the metarostrum is twice as long as the head and hardly narrowed before the antennæ; the prorostrum is short, naked, dark reddish brown. The antennæ are inserted near the apex of the rostrum: the 3rd joint is longer than the 4th, the 4th a little longer than the 5th, the 7th and 8th subequal; the three apical joints are distinct, slightly thickened and finely pubescent.

The prothorax is similarly shaped as in *D. furcillatus* (Gylh.), but comparatively broader; its upper surface is covered with

large irregular punctures, and marked on each side with a longitudinal line of rounded white scales, and in the middle with a line of small scales; moreover, punctiform scales are sunk in the punctures.

The elytra are slightly broader at the base than the prothorax in the middle, the sides are parallel, the apex is normally narrowed; they have above three narrow longitudinal costæ, the interstices between which are punctate and provided with rounded scales; the sides are foveate, each fovea shows a setiform scale; moreover, a line of rounded scales is present along the lateral margin; the outer angles of the elytra at the apex are simply toothed.

The metasternum and the base of the abdomen are covered with rounded scales; the rostrum beneath and the legs are scattered with scale-like setæ. The 3rd abdominal segment is short and contracted in the middle.

♀. Agrees with the male in all respects except the following:—The body is broader; the head short, nearly square; the metarostrum is shorter, as long as the head; the prorostrum much more elongate, longer than the metarostrum; the antennæ are inserted between the middle of the rostrum and its base; they are comparatively shorter and stouter; the 3rd abdominal segment is longer and not contracted.

Length 17–23 mm.

Hab. Kuching (N.W. Borneo).

Allied to *D. furcillatus* (Gylh.), but the new species has the head shorter and the eyes more prominent; the prorostrum is shorter; the joints of the antennæ are longer, the three apical ones more distinct; the apex of the elytra are broader and slightly toothed; the body is shorter and stouter. The female of the new species is, moreover, distinguished by the metarostrum which is shorter, and by the antennæ which are inserted before the middle of the rostrum.

I have named this species in honour of Mr. R. Shelford, who has kindly presented an interesting collection of Bornean Brenthids to the Oxford University Museum.

DIURUS SILVANUS Senna. (Plate XX. fig. 4, ♀.)

The female of this species being hitherto undescribed, I give a short description of it:—

The head is nearly square, with a fovea between the eyes; the metarostrum is short, hardly so long as the head, channelled above, and slightly narrowed before the antennæ; the prorostrum is slender, glossy, finely punctured, as long as the head and metarostrum taken together. The antennæ, which are consequently more approximate to the base than to the apex of the rostrum, are rather stout, with the 3rd joint longer than the 4th, the 6th and 7th subequal, the 8th a little shorter, the three apical joints well distinct and separate. The prothorax is strongly contracted anteriorly, the sides towards the middle are almost

parallel. The elytra are longer than twice the prothorax, narrowed at and sloping rapidly to the apex; the tails are more approximate than those of *D. furcillatus* (Gylh.); moreover, they are short and almost straight.

This species, by the shape of the elytra at the apex, is allied to *D. erythropus* (Rits.), but easily distinguished by the longer pro-rostrum, by the insertion of the antennæ being more approximate to the base of the rostrum, and by the three apical joints being well distinct and separated.

Length 30 mm. (the tails excluded).

Hab. Matang (Borneo).

EXPLANATION OF THE PLATES.

Plate XIX.

Figures 16 to 19 are about twice the natural size: the remainder about $\frac{6}{7}$ of the natural size.

Fig 1. *Tricondyla cyanea* (Lep.), var *wallacei* (Thoms.).	Kuching, Feb. 1899.
2. *Condylodera tricondyloides* (Westw.), mature individual.	Kuching, March 2, 1900.
3. *Tricondyla gibba* (Chaud.).	Matang, Aug. 1899.
4. *Condylodera tricondyloides* (Westw.), immature individual.	Kuching, Dec. 12, 1899.
5. *Collyris sarawakensis* (Thoms.).	Kuching, May 14, 1900.
6. *Condylodera tricondyloides* (Westw.), very young individual.	Kuching, July 18, 1900
7. *Pheropsophus agnatus* (Chaud.).	Kuching, Aug 20, 1897.
8. *Gryllacris*, n. sp. vicinissima *nigratæ* (Br.).	Sarawak.
9. *Alcides* sp.	Kuching, April 20, 1900.
10. *Issus bruchoides* (Walk.).	Kuching, Sept. 14, 1899.
11. *Sclethrus amœnus* (Gory).	Kuching, May 14, 1900.
12. *Psebena brevipennis* (Gahan).	Kuching, Dec. 4, 1899.
13. *Oberea strigosa* (Pasc.), var., from left side.	Kuching, July 26, 1899.
14. *Oberea brevicollis* (Pasc.), from left side.	Kuching, March 15, 1899.
15. *Oberea*, probably n. sp. near *strigosa* (Pasc.), from left side.	Matang, March 14, 1898.
16. Larva of *Eulyes amœna* (Fab.), from right side.	Kuching, probably 1899.
17. Larva of *Hymenopus bicornis* (Stoll), from right side.	Kuching, probably 1899.
18. Larva of *Eulyes amœna* (Fab.), dorsal view.	Kuching, probably 1899.
19. Larva of *Hymenopus bicornis*, dorsal view.	Kuching, probably 1899.
20. *Salius aurosericeus* (Guér.).	Kuching, July 3, 1899.
21. *Nothopeus intermedius* (Gahan), ♂.	Penrissen, May 1899.
22. *Bracon* sp.	Matang, Aug. 1899.
23. *Mantispa simulatrix* (McLachl.).	Matang, Aug. 1899.
24. *Polistes* sp. near *diabolicus* (Sauss.).	Kuching, July 27, 1899.
25. *Mantispa* sp	Kuching, July 12, 1900.
26. *Polistes sagittarius* (Sauss.).	Kuching, July 2, 1898.
27. *Mantispa* sp.	Matang, 3600 ft., June 1900.

Plate XX.

Figures 4 *a*, 7 *a*, 8 *a*, and 10 *a* are about 4 times the natural size: the remainder about $\frac{8}{10}$ of the natural size.

Fig 1. *Baryrhynchus dehiscens* (Sch.), ♂.	Matang, Aug. 1899.
2. *Baryrhynchus dehiscens* (Sch.), ♀.	Kuching, 1899.
3. *Alibora* sp.	Kuching, Aug. 10, 1899.
4. *Diurus silvanus* (Senna), ♀.	Matang, Aug. 1899.
4 *a*. Left elytron of above. Dorsal view of apex, × 4.	
5. *Diurus forcipatus* (Westw.), ♂.	Kuching, Sept. 14, 1899.
6. *Diurus shelfordi* (Senna), ♀.	Kuching, Nov. 2, 1899.

Fig. 7.	*Ægoprepis insignis* (Pasc.).	Matang, Aug. 1899.
7 *a*.	Left elytron of above. Dorsal view of apex, × 4.	
8.	*Stegenus dactylon* (Pasc.).	Kuching, Oct. 31, 1900.
8 *a*.	Left elytron of above. Dorsal view of apex, × 4.	
9.	*Dymascus porosus* (Pasc.).	Kuching, July 9, 1900.
10.	*Ectatosia moorei* (Pasc.).	Kuching, April 3, 1900.
10 *a*.	Left elytron of above. Dorsal view of apex, × 4.	
11.	*Ænidia* sp.	Kuching, Feb. 1899.
12.	*Serixia prolata* (Pasc.).	Kuching, Sept. 20, 1899.
13.	*Metrioidea apicalis* (Jac.), var.	Kuching, Aug. 1, 1899.
14.	*Entelopes*, n. sp. near *wallacei* (Pasc.).	Sarawak.
15.	*Aulacophora luteicornis* (Fab.), var.	Sarawak.
16.	*Tropimetopa simulator* (Pasc.).	Kuching, Aug. 4, 1897.
17.	*Ochralea nigripes* (Oliv.), var.	Kuching, March 28, 1900.
18.	*Astathes unicolor* (Pasc.)=*coccinea* (Pasc.).	Kuching, Aug. 17, 1898.
19.	*Caritheca mouhoti* (Baly).	Kuching, Aug. 8, 1899.
20.	*Astathes splendida* (Fab.).	Kuching, Aug. 1899.
21.	*Antipha ? nigra* (Alld.), var.	Kuching, Aug. 11, 1899.
22.	*Astathes posticalis* (Thoms.).	Kuching, Aug. 15, 1899.
23.	*Haplosonyx albicornis* (Wied.).	Brit. N. Borneo, Sandakan, about 1895-6. A. L. Cook.
24.	*Astathes caloptera* (Pasc.) = *cyanipennis* (Thoms.).	Brit. N. Borneo, Sandakan, about 1895-6. A. L. Cook.
25.	*Aulacophora boisduvali* (Baly).	Kuching, Sept. 13, 1899.
26.	*Entelopes amœna* (Pasc.).	Matang, Dec. 1898.
27.	*Ænidia* sp. near *læta* (Baly).	Penrissen, May 1899.
28.	*Chreonoma*, ? n. sp.	Penrissen, May 1899.
29.	*Xylotrechus pedestris* (Pasc.).	Kuching, March 28, 1900.
30.	*Cylindrepomus peregrinus* (Pasc.).	Kuching, March 28, 1900.
31.	*Chlorophorus annularis* (Pasc.).	Pankalan Ampat, 5–6000 ft., base of Penrissen, May 1899
32.	*Cylindrepomus comis* (Pasc.).	Kuching, March 29, 1900.
33.	*Cylindrepomus* ? form of *comis* (Pasc.).	Matang, Aug. 1899.
34.	*Daphisia* sp. ♀.	Matang, 3600 ft., June 1900.
35.	*Demonax viverra* (Pasc.).	Penrissen, 4500 ft., May 17, 1899.
36.	*Daphisia* sp.	Kuching, Aug. 4, 1897.
37.	*Clytanthus sumatrensis* (Lap. & Gor.).	Trusan.
38.	*Cryllis clytoides* (Pasc.).	Kuching, July 17, 1899.
39.	*Demonax mustela* (Pasc.).	Pankalan Ampat, 5–6000 ft., base of Penrissen, May 1899.
40.	*Leptura* sp.	Penrissen, May 1899.
41.	*Xylotrechus decoratus* (Pasc.).	Penrissen, May 1899.
42.	*Leptura* sp. near *histrionica* (Pasc.).	Penrissen, 4200–4500 ft., May 1899.
43.	*Chloridolum cinnyris* (Pasc.).	Penrissen, May 1899.
44.	*Leptura*, ? n. sp.	Matang, Aug. 1899.
45.	*Chloridolum* sp. near *thomsoni* (Pasc.).	Penrissen, May 1899.
46.	*Chloridolum thomsoni* (Pasc.).	Kuching, July 20, 1900.
47.	*Saperdides*, ? gen. ? sp.	Matang, March 13, 1898.
48.	*Xystrocera alcyonea* (Pasc.).	Kuching, Sept. 7, 1897.

Plate XXI.

The figures are rather over $\frac{2}{3}$ of the natural size.

Fig. 1.	*Delias pandemia* (Wallace), ♂.	Borneo.
2.	*Isbarta pandemia* (Rothsch.).	Kina Balu Mt., Borneo, about 1896.
3.	*Delias aglaia* (Linn.), ♀.	Brit. N. Borneo. Pryer, 1878-98.
4.	*Isbarta dissimulata* (Walk.).	Sarawak. Wallace.
5.	*Delias cathara* (Grose-Smith).	Penrissen, 3500 ft., May 19, 1899.
6.	*Callamesia* (*Cyclosia*) *pieridoides* (Walk.).	Penrissen, 3500 ft., May 19, 1899.
7.	*Scrobigera hesperoides* (Walk.).	Limbang River, N. of Sarawak, April 1895. E. Bartlett.

Fig. 8. *Eterusia obliquiaria* (Walk.). — Saribas, 100 miles N.E. Kuching, Nov. 1900.
9. *Danisepa lowei* (Butl.). — Brit. N. Borneo, Sandakan, about 1895–6. A. L. Cook.
10. *Mimeuplœa rhadamantha* (Butl.), ♂. — Kuching, Nov. 1895.
11. *Penoa menetriesii* (Feld.). — Borneo.
12. *Mimeuplœa tristis* (Jordan), ♀. — Kuching, Oct. 1895.
13. *Trepsichrois mulciber* (Cram.). — Brit. N. Borneo, Sandakan, about 1895–6. A. L. Cook.
14. *Pompelon marginata* (Guér.). — Sarawak. Wallace.

Plate XXII.

Figures 1 and 2 are about ⅔ of the natural size: the remainder about ⅘ of the natural size.

Fig. 1. *Xylocopa latipes* (Drury). — Matang, March 1898.
2. *Hyperechia fera* (v. d. Wulp). — Kuching, Feb. 1899.
3. *Collyris emarginata* (Macl.). — Mt. Serambu, Dec. 1898.
4. *Sepedon* sp. near *javanicus* (Desv.). — Mt. Serambu, Dec. 1898.
5. *Mesostenus* sp. near *pictus* (Smith). — Penrissen, May 1899.
6. Gen. et sp.? Fam. Stratiomyidæ, Subfam. *Raphiocerinæ*. — Penrissen, May 1899.
7. *Mesostenus* sp. — Pankalan Ampat, 5–6000 ft., base of Penrissen, May 1899.
8. ? *Xylophagus* sp. — Penrissen, May 1899.
9. *Salius sericosoma* (Smith). — Kuching, Feb. 2, 1898.
10. *Laphria* sp. near *terminalis* (v. d. Wulp). — Kuching, July 29, 1899.
11. *Macromeris violacea* (Lep.). — Matang, March 13, 1898.
12. *Midas* n. sp. — Mt. Santubong, Aug. 1900.
13. *Vespa cincta* (Fab.). — Matang, 3600 ft., June 1898.
14. *Milesia vespoides* (Walk.). — Kuching, April 3, 1900.

Plate XXIII.

The figures are slightly reduced.

Fig. 1. *Ectatops rubiaceus* (A. & S.). — Matang, Dec. 1897.
2. *Serinetha abdominalis* (Fab.). — Botanic Gardens, Singapore, Jan. 1899.
3. *Phauda limbata* (Wllgrn.). — Botanic Gardens, Singapore, Jan. 1899.
4. *Lycostomus gestroi* (Bourg.), ♀. — Kuching, July 12, 1899.
5. *Lycostomus gestroi* (Bourg.), ♂. — Mt. Santubong, 2600 ft., Feb. 4, 1900.
6. *Erythrus rotundicollis* (Gahan), ♂. — Mt. Santubong, 2600 ft., Feb. 4, 1900.
7. *Erythrus sternalis* (Gahan), ♂. — Matang, 3600 ft., June 1900.
8. *Erythrus apiculatus* (Pasc.), var. — Matang, Aug. 1899.
9. Rhipidoceridæ, ? gen. *Ennomates*. — Matang, Dec. 1898
10. Eucnemidæ, ? gen. ? sp. — Kuching, July 2, 1900.
11. *Calochromus* (*Micronychus*) *dispar* (C. Waterh.), ♀. — Matang, Aug. 1899.
12. *Pyresthes virgata* (Pasc.). — Matang, 3600 feet, June 1900.
13. *Eurycephalus lundi* (Fab.). — Kuching, May 7, 1900.
14. *Tenerus sulcipennis* (Gahan). — Kuching, March 14, 1900.
15. *Gonophora wallacei* (Baly), var. — Kuching, May 28, 1900.
16. *Metriorrhynchus kirschi* (C. Waterh.), ♂. — Kuching, Aug. 15, 1899.
17. „ „ (C. Waterh.), ♂. — Kuching, May 28, 1900.
18. *Ephies dilaticornis* (Pasc.), var. ♂. — Matang, 3600 ft., June 1900.
19. *Erythrus biapicatus* (Gahan), ♀. — Matang, 3600 ft., June 1900.
20. *Agonischius* ? *sanguinicipennis* (Cand.). — Kuching, May 16, 1900.
21. *Agonischius pectoralis* (Cand.). — Kuching. May 16, 1900.
22. Reduviid sp. — Sarawak.
23. *Melampyrus acutangulus* (Bourg.), ♂. — Matang, Aug. 1899.
24. *Cantires excellens* (C. Waterh.), ♀. — Kuching, Sept. 6, 1899.

Fig. 25. *Xyaste fumosa* (Pasc.).	Kuching, March 23, 1900.
26. *Xyaste invida* (Pasc.).	Kuching, July 10, 1899.
27. *Gonophora wallacei* (Baly).	Kuching, Aug. 1897.
28. *Taphes brevicollis* (C. Waterh.), ♀.	Kuching, Jan. 24. 1900.
29. *Ditoneces* sp. near *fuscicornis* (Gorh.).	Kuching, Sept. 6, 1899.
30. *Caria dilatata* (Fab.).	Matang, March 13, 1898.
31. *Prioptera octopunctata* (Fab.).	Sarawak.
32. *Entelopes glauca* (Guér.).	Penrissen, May 1899.
33. *Blachia ducalis* (Walk.).	Kuching, Dec. 13, 1900.
34. Locustid of new genus near *Gammarotettix*.	Kuching, Feb. 2, 1901.
35. *Lema quadripunctata* (Oliv.).	Kuching, Oct. 12, 1899.
36. *Apoderus javanicus* (Jekel).	Kuching, April 4, 1900.
37. Pterophorid, probably near genus *Coremaguia*.	Kuching, Jan. 16, 1901.
38. *Bracon* sp.	Kuching, April 24, 1900.
39. Homopteron of genus probably near *Brixia*.	Kuching, Jan. 17, 1901.
40. *Epania singaporensis* (Thoms.).	Penrissen, May 1899.
41. *Melipona vidua* (Lepel.).	Kuching, May 8, 1900.
42. Capsid sp.	Kuching, June 22, 1900.
43. *Holocephala ? hirsuta* (v. d. Wulp).	Kuching, May 3, 1900.
44. *Megalocolus notator* (Walk.).	Kuching, April 24, 1900.
45. Reduviid sp.	Kuching, Sept. 16, 1899.
46. *Toxophora*, n. sp. near *javana* (Wied.).	Kuching, May 16, 1900.
47. *Bracon* sp.	Kuching, Aug. 11, 1900.
48. *Mutilla* sp. near *urania* (Smith).	Kuching, July 17, 1899.
49. *Tillicera*, n. sp.? near *T. bibalteata* (Gorh.).	Kuching, Aug. 1899.
50. *Cladophorus atrofuscus* (C. Waterh.), ♀.	Kuching, March 15, 1900.
51. " " (C. Waterh.), ♀.	Kuching, April 14, 1900.
52. *Tenerus sulcipennis* (Gahan).	Kuching, March 30, 1900.
53. *Callimerus bellus* (Gorh.).	Kuching, Dec. 13, 1899.
54. *Callimerus catenatus* (Gorh.).	Kuching, Oct. 6, 1899.
55. *Daphisia pulchella* (Pasc.).	Kuching, June 19, 1900.
56. *Spathomeles*, n. sp. near *S. turritus* (Gerst.).	Kuching, Oct. 15, 1897.
57. *Zelota spathomelina* (Gahan).	Kuching, Dec. 12, 1899.
58. *Erythrus viridipennis* (Gahan).	Matang, 3000 ft., June 1900.
59. *Prionocerus cœruleipennis* (Perty).	Kuching, May 4, 1900.
60. *Tetralanguria pyramidata* (Fab.).	Kuching, Dec. 8, 1899.
61. *Botryonopa cyanipennis* (Baly).	Kuching, Feb. 24, 1899.

2. On the Classification of the Fishes of the Suborder Plectognathi; with Notes and Descriptions of new Species from Specimens in the British Museum Collection. By C. Tate Regan, B.A.[1]

[Received September 26, 1902.]

(Plates XXIV. & XXV.[2] and Text-figures 56–59.)

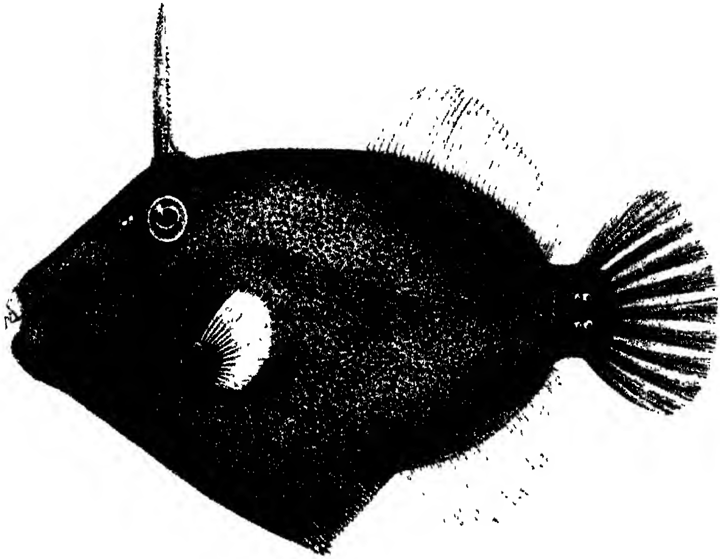
Part I.—Classification.

In the systematic account which follows are embodied the results of a study of the Plectognathous fishes, and especially of their osteology, which I have made. The numerous characters of importance which have hitherto been overlooked or misunderstood by ichthyologists will serve as an apology for the present paper. My sincere thanks are due to Mr. Boulenger for criticism and suggestions, which his wide experience has made invaluable.

The Plectognathi are here treated of as a distinct suborder, as

[1] Communicated by G. A. Boulenger, V.P.Z.S.

[2] For explanation of the Plates, see p. 303.



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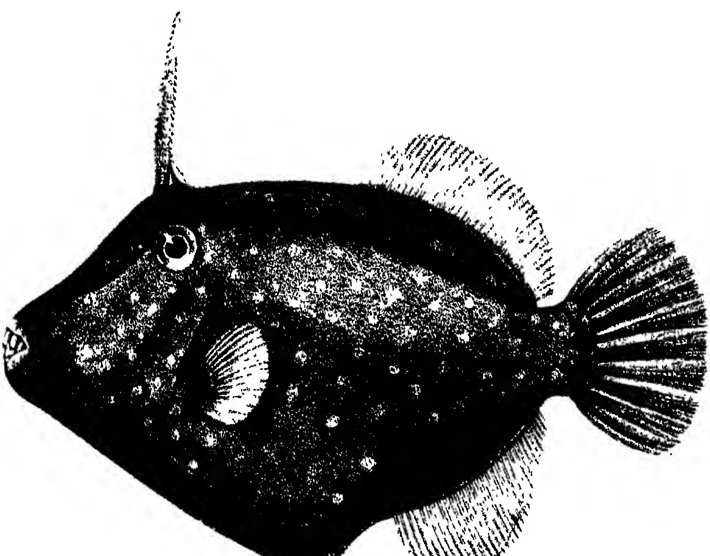

1.

J. Green del et lith

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1. PSEUDOMONACANTHUS MULTIMACULATUS.
2. PSEUDOMONACANTHUS PUNCTULATUS.

although there can be no question as to the close relationship of the less specialized forms to the Acanthuridæ, their differences from that family are sufficiently great to admit of a definition which separates them from the Acanthopterygii, and at the same time includes the more aberrant and specialized forms.

The feature of most importance in diagnosing the suborder Plectognathi is the absence of ribs, although in some well-ossified epipleurals are present which have been mistaken for ribs. Two divisions are recognized, for which the names Sclerodermi and Gymnodontes, originally proposed by Cuvier, are retained. The Triodontidæ, however, are removed from the latter division and placed in the former, the structure of their pectoral arch and vertebral column, as well as the presence of a pelvis and of well-ossified epipleurals, indicating their close relationship to the Triacanthidæ and Balistidæ; whilst the coalescence of the teeth in the jaws is a feature of little importance, and has, as probably as not, originated independently in these fishes and in the Gymnodontes.

The Ostraciontidæ do not seem to me to differ sufficiently from the Sclerodermi to rank as another division—Ostracodermi. Their very close relationship to the Balistidæ is apparent in their physiognomy and in the structure of their skeleton; whilst the absence of epipleurals and of the pelvis is obviously due to the development of the exoskeleton, which, however, is not very different from that of *Balistes*, many species of which have exoskeletal plates distinctly hexagonal in certain areas. I have inserted notes after the diagnoses, explaining the omission of characters before used or the addition of those now used for the first time.

Suborder PLECTOGNATHI.

Similar to the Acanthopterygii, but without ribs; with the post-temporal short, simple, and completely united by suture to the squamosal, and the pelvic bones, if present, more or less completely co-ossified. Branchial apertures very restricted. Premaxillaries and maxillaries often firmly united, opercular bones more or less reduced, and scales usually osseous or spinate.

Cuvier characterized the Plectognathi as having no ribs, but other systematists have generally agreed that ribs are present in *Balistes*, *Triacanthus*, *Triodon*, &c. I find that the so-called ribs of the Triacanthidæ and Balistidæ are epipleurals, which are attached to the anterior caudal vertebræ as well as to the præcaudals (text-fig. 56, p. 286), and are intermuscular bones, not bordering the abdominal cavity. I have unfortunately had no opportunity of examining the skeleton of *Triodon*, but have had to rely on the memoirs of Hollard [1] and Dareste [2]; but I think I am justified in supposing that in *Triodon*, as in *Balistes* and *Triacanthus*,

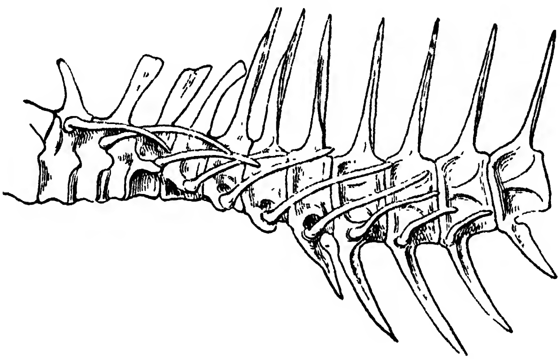
[1] Ann. Sci. Nat. (3) xx. 1853, p. 71; (4) viii. 1857, p. 275, and (4) xiii. 1860, p. 1.
[2] Ann. Sci. Nat. (3) xii. 1849, p. 68, and (3) xiv. 1850, p. 105.

which it so closely resembles in other skeletal characters, the so-called ribs are epipleurals.

In the Plectognathi the post-temporal is more reduced and more intimately connected with the skull than in the Acanthuridæ, in which family it is attached by its proximal and distal ends, but separated from the skull by a foramen for most of its length.

The co-ossification of the pelvic bones is more complete in these fishes than in the Acanthuridæ.

Text-fig. 56.



Præcaudal and anterior caudal vertebræ, with epipleurals, of *Balistes aculeatus*.

In Dr. Gill's diagnosis of the Plectognathi occur the words: "The elements of the lower jaw consolidated into two pieces representing the rami;" this applies very well to the Sclerodermi, but in the Gymnodontes the suture between dentary and articulare is quite evident, and in *Mola* at any rate these bones can scarcely be described as consolidated. Another character used by Gill to define the Plectognathi is "Interoperculum detached from the other opercular bones, reduced and more or less rod-like in form." I find that in the Sclerodermi this bone is rod-like anteriorly, and posteriorly expanded and attached to the sub-operculum, this posterior portion being in some cases, e. g. *Triacanthus*, strongly ossified, in others, e. g. *Ostracion*, almost entirely membranous. In the Gymnodontes it is rod-like, but only in the Tetrodontidæ is it unconnected posteriorly with the suboperculum.

Division I. SCLERODERMI[1].

Supraclavicle vertical; pterygials (pectoral basalia) not enlarged, movably attached by ligament to the scapula and coracoid, three to the former and one to the latter. All the vertebræ with the neural arches forming a single spine. *Basis cranii* more or less distinctly double. Dentary and articulare completely co-ossified.

[1] *Trachycephalus* De Vis (*nec* Tschudi), described as a Scleroderm in Proc. Linn. Soc. N.S.W. viii. 1883, p 455, is evidently not a Plectognath.

Spinous dorsal, if present, of few rays; no anal spines; ventrals, if present, each represented by a spine (rarely with the addition of one or two rudimentary soft rays). Caudal rays in small number, ten to eighteen.

Four families: Triacanthidæ, Triodontidæ, Balistidæ, and Ostraciontidæ.

In the fishes of this division the pectoral arch is very similar to that of the Acanthuridæ, except that the post-temporal is completely united suturally to the squamosal. The vertebral column also is like that of Perciform fishes; and although Dareste has ascribed to *Triodon* diapophyses on the posterior præcaudal and most of the caudal vertebræ, it is evident, from studying his figure and comparing with skeletons of *Triacanthus* and *Balistes*, that he is referring to the præzygapophyses, which are somewhat enlarged in this region in all these fishes.

Family 1. TRIACANTHIDÆ.

Præcaudal vertebræ with parapophyses from the third or fourth to the last; epipleurals present. Præorbital not ossified; ethmoid region high, a large nasal cavity bounded by ethmoid and præfrontal; palatine arch firmly united to the skull; premaxillaries protractile, free from the maxillaries; teeth in the jaws separate, conical or incisor-like; palate toothless; fourth upper pharyngeals toothed; lower pharyngeals separate; opercular bones reduced, but with their normal relations. Pelvis present, firmly united to the pectoral arch. Two nostrils on each side. Four gills, a slit behind the fourth; pseudobranchiæ present; six branchiostegals. Scales small, sometimes spinate or osseous. Spinous dorsal with two to six spines; soft dorsal and anal of moderate length or rather short; ventrals each represented by a strong spine, with an inner basal knob which locks it when everted, rarely with the addition of one or two rudimentary soft rays. Air-bladder present.

Genera.

1. TRIACANTHUS[1] Cuv. Body compressed, caudal peduncle long and slender. Scales small, rough. Lateral line present. D. IV V, 22 25; A. 16-20. Ventrals without soft rays. Caudal forked, with 12 rays. A series of incisors in each jaw, with a few inner rounded teeth. Twenty vertebræ.

2. TRIACANTHODES[2] Bleeker. — Body compressed, caudal peduncle short. Scales small, juxtaposed. No distinct lateral

[1] The Oligocene genus *Acanthopleurus* Agassiz has a rounded caudal, but in other respects seems scarcely different from *Triacanthus*.

[2] *Spinacanthus* Agassiz, from the Eocene of Monte Bolca, may belong to this family. It resembles *Triacanthodes* in its dorsal, anal, and caudal fins, except that the six dorsal spines are very long and strong. The eye is placed high, below the first dorsal spine, and the teeth are stout and conical. The pelvis and ventral fins were apparently not strongly developed, and Gill considers this fish to be the type of a separate family.

line. Dorsal with V–VI spines. Soft dorsal and anal rather shorter than in *Triacanthus*; ventrals usually with one or two rudimentary soft rays; caudal rounded. Jaws with a series of conical teeth, and usually a few inner teeth. *Hollardia* Poey seems not distinct from this genus.

3. HALIMOCHIRURGUS Alcock.—Body low, compressed, with short caudal peduncle. Scales small, spinate. No lateral line. Snout much produced, lower jaw projecting. D. II, 13; A. 12. Ventrals without soft rays. Caudal rounded. Teeth very small, conical, in a single series.

Family 2. TRIODONTIDÆ.

Præcaudal vertebræ without parapophyses; epipleurals well-developed. Premaxillaries not protractile, firmly united to the maxillaries; teeth in the jaws coalescent. Pelvis represented by a single long bone, movably attached to the pectoral arch. No spinous dorsal; soft dorsal and anal short; no ventrals. Abdomen with a dilatable sac, kept expanded by the movable pelvis; lower part of sac a flap of skin into which the air does not enter. In other characters like the Triacanthidæ.

Genus.

TRIODON.—Body compressed, caudal peduncle long and slender. Scales osseous. Caudal forked, with 18 rays. Twenty vertebræ.

Although unable to examine a skeleton of this genus, a study of the figures and descriptions published has convinced me that the skull, vertebral column, and pectoral arch are extremely like those of *Triacanthus*, whilst the scales, movable pelvis, ventral sac and flap are similar to those of the Balistidæ. The only features which link this family to the Tetrodontidæ, in the neighbourhood of which it has generally been placed, are the comparatively unimportant characters of the coalesced teeth and absent spinous dorsal. It would be interesting to know whether the fourth upper pharyngeals are well-developed and toothed, as in *Triacanthus*, or rudimentary and toothless, as in *Balistes*.

Family 3. BALISTIDÆ.

Præcaudal vertebræ with well developed parapophyses to which epipleurals are attached. Præorbital more or less ossified. Ethmoid region long, without distinct nasal cavities. Palatine movably articulated with ectopterygoid, or else entirely free from it. Premaxillaries not protractile, firmly united to the maxillaries. Fourth upper pharyngeals rudimentary, not toothed. Incisor-like teeth in the jaws. Pelvis long, movable. Spinous dorsal with one to three spines, the first, if strong, followed by a second which locks it when erected. Soft dorsal and anal long or of moderate length. Ventrals, if present, represented by a single

short rough spine at the end of the pelvis. Most of the præcaudal interneurals co-ossified to form a bony trough, attached to the skull, and receiving the retracted dorsal spines. In other characters similar to the two preceding families.

Genera.

1. BALISTES Linn.[1]—Body compressed, caudal peduncle short. Scales moderate or large, juxtaposed, osseous. Jaws usually even in front. Gill-openings behind the eyes. Dorsal usually with 3 spines—the first strong and just behind the eye, the second locking it when erected, the third, if present, remote from them. Soft dorsal with 23-35 rays. Anal with 20-30. Caudal rounded or truncate, the outer rays often more or less produced. Pelvis projecting. Ventrals represented by a short, rough, movable spine. The movable pelvis, abdominal sac, and ventral flap are very similar to those of *Triodon*, but much less developed. Palatine T-shaped, the cross piece articulating with ethmoid and maxillary, the vertical limb with the ectopterygoid. Vertebræ 18.

2. MONACANTHUS Cuv.—Differs from *Balistes* in that the scales are smaller; the palatine is a straight rod attached to maxillary and ethmoid, having lost the lower vertical limb which in *Balistes* articulates with the ectopterygoid; the third dorsal spine is always absent and the caudal always rounded. The first dorsal spine is above the eye, and if it has distinct barbs these are usually arranged in two series. The gill-openings are often below the posterior part of the eye. There are 18 vertebræ.

In this genus are included all those species of *Monacanthus*, as understood by Günther, with a movable ventral spine.

The transition is perfect from those with a rough dorsal spine without distinct barbs, to those with a series of minute barbs on each side, and so to those with barbs strongly developed.

M. penicilligerus Cuv. belongs to this genus, the ventral spine being movable, and the barbs on the dorsal spine exactly similar to those of the closely-allied *M. tomentosus*, although their regular arrangement is obscured by the well-developed fleshy filaments. In the development of the ventral sac and flap, some species of this genus almost rival *Triodon*.

3. PARALUTERES Bleeker. Differs from *Monacanthus* in that the single dorsal spine is weak, not fully erectile, and the ventral spine is absent, or small and fixed.

4. PSEUDALUTERES Bleeker.—Differs from *Monacanthus* in that the dorsal spine is in advance of the orbit, the ventral spine is absent, and the pelvis is entirely concealed.

5. PSEUDOMONACANTHUS Bleeker.—Differs from *Monacanthus* in that the ventral spine is immovable, ankylosed to the pelvis, and

[1] The Oligocene genus *Acanthoderma* Agassiz is scarcely distinguishable from *Balistes*.

the barbs of the dorsal spine, if distinct, are usually in four series. There are 19 or 20 vertebræ. In this genus the gradation is perfect from those species without barbs to those with four equidistant series of strong barbs.

6. ALUTERA Cuv.—Differs from *Pseudomonacanthus* in that the dorsal spine is feeble, the ventral spine is absent, the pelvis is entirely concealed, and the dorsal and anal rays usually in greater number. The lower jaw is projecting, the gill-openings oblique and below the eye, and the vertebræ number 21.

7. PSILOCEPHALUS Swainson.—Differs from *Alutera* in its more elongate body, very feeble dorsal spine, lower jaw with a barbel, gill-openings in advance of the eye, and vertebræ numbering 29–30.

This family has well-defined characters, and the relations of the various genera are very clear; its division into subfamilies is without value, and if *Balistes* and *Psilocephalus* are to rank as distinct families, *Monacanthus*, *Alutera*, *Paraluteres*, and *Pseudaluteres* should receive the same treatment, and the Balistidæ (as here understood) be raised to the rank of a division.

Some authors have stated that the symplectic is not ossified in the fishes of this and the next family. I find that in all cases it is present as a small but distinct ossification attached to the lower margin of the metapterygoid between stylo-hyal and quadrate; the stylo-hyal has shifted its attachment forwards from the hyomandibular to the anterior part of the lower margin of the metapterygoid, and has, as it were, pushed the symplectic in front of it.

Family 4. OSTRACIONTIDÆ.

Closely allied to the Balistidæ, but with feeble parapophyses, no epipleurals, præorbital not ossified, palatine immovable, pelvis absent, no spinous dorsal, no ventrals, soft dorsal and anal short. Clavicles, coracoids, and post-clavicles much expanded. Scales represented by large, juxtaposed, bony plates, mostly hexagonal and immovably united.

Genera.

1. ARACANA Gray.—Body ovate or orbicular. Carapace ceasing before the dorsal and anal fins, with more or less distinct longitudinal ridges, 3 on each side, and often a dorsal and ventral ridge; some isolated plates on the caudal peduncle. D. 10–12. A. 10–12. Caudal truncate or rounded. Sixteen vertebræ, not elongate, subequal in length except the two preceding the square hypural, which are shortened.

2. OSTRACION Linn.—Body 4- or 5-sided; carapace extending beyond and closed behind the anal fin, with two prominent ridges on each side and often a dorsal ridge. Caudal peduncle naked. D. 9–10. A. 9–10. Caudal truncate or rounded. Sixteen

vertebræ, not elongate, subequal in length except the three preceding the square hypural, which are extremely shortened.

3. LACTOPHRYS Swainson.— Body 3-sided; carapace with three prominent ridges, a dorsal and two ventro-lateral. Vertebræ fourteen, the first eight elongate, the four preceding the oblong hypural shortened. In other characters like *Ostracion*.

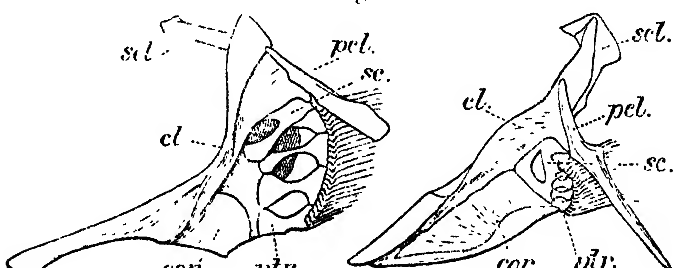
Division 2. GYMNODONTES.

Supraclavicle oblique, sometimes nearly horizontal; lower three pterygials enlarged and immovably united to the coraco-scapular cartilage; upper pterygial small, suturally united to the scapula (see text-fig. 57). Anterior vertebræ with bifid divergent neural spines. *Basis cranii* simple. Suture between dentary and articulare evident. Pelvis absent. No spinous dorsal; no anal spines; no ventrals; caudal rays, if present, ten to twelve in number.

Three families: Tetrodontidæ, Diodontidæ, Molidæ.

I cannot find that the true interpretation of the bones of the pectoral arch in these fishes has been previously published. On a superficial examination there appears to be no scapula, and the pectoral fin to be supported by a series of four enlarged pterygials. In fact, the united upper pterygial and scapula together resemble one of the enlarged pterygials, both in size and shape, whilst the

Text-fig. 57.



Right half (inner side) of pectoral arches of (A) *Diodon punctulatus* and (B) *Balistes verrucosus*.

scl., supraclavicle; *cl.*, clavicle; *pcl.*, postclavicle; *sc.*, scapula; *cor.*, coracoid; *ptr.*, pterygials.

scapular foramen corresponds to one of the series of interspaces between them. The feature of the pterygials being immovably attached to the scapula and coracoid, either directly or synchondrosially, is worth notice. The pectoral arch is so strikingly similar in all three families, that Siebenrock's suggestion that in *Mola* the bone which attaches the clavicle to the skull is the post-temporal, and not the supraclavicle as in Tetrodontidæ, cannot be accepted.

It has been asserted that the term *spina bifida* is not correctly applied to the neural spine of the anterior vertebræ in these fishes, because the neural canal is closed; but in the Molidæ this is not the case, and in the Diodontidæ the neural canal is open above in the posterior præcaudal region; the anterior bifid spines are in all cases obviously homologous and forming one series with the single neural spines which succeed them, and when the neural canal is closed by a bony roof this must be regarded as a secondary feature, due to the meeting of outgrowths from the base of the neural spine of each side after they have separated.

Family 1. Tetrodontidæ.

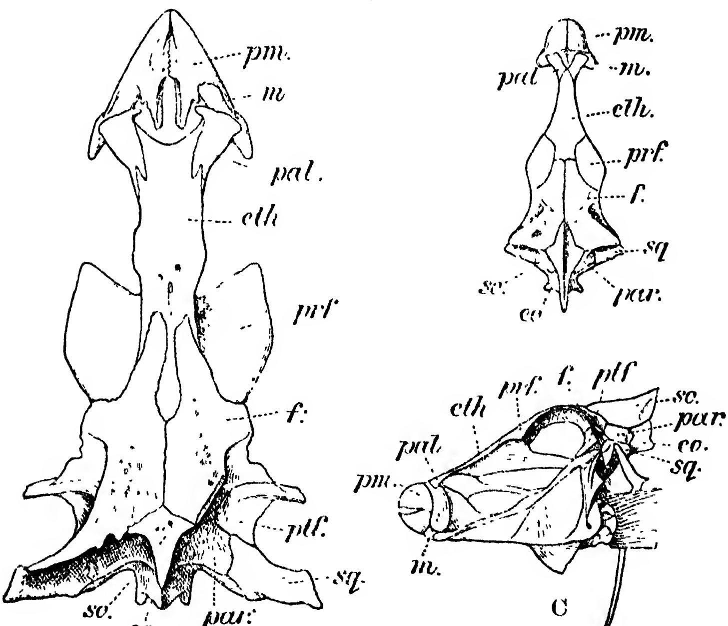
Præcaudal vertebræ without parapophyses, the first four or five with bifid neural spine and closed neural arch; no epipleurals. Præorbital not ossified; palatine firmly united to the skull; no distinct bony nasal cavity; premaxillaries not protractile, united to maxillaries; teeth in the jaws coalescent, in each forming a beak with median suture; palate toothless; fourth upper pharyngeals present, toothed; lower pharyngeals separate; interoperculum a long rod, attached to inner face of præoperculum, sometimes connected with operculum, never with suboperculum. Nostrils various. Four branchial arches, the fourth not bearing a gill, not followed by a slit; pseudobranchiæ present; six branchiostegals, the first a broad plate. Skin naked, usually with movable spines, rarely with bony plates. Caudal peduncle normal. Skeleton well-ossified. Belly very inflatable. Air-bladder present.

Many authors have failed to understand the evolution of the nasal organs in this family, as is shown by the wording of their diagnoses, such phrases as "nostrils represented by two solid tentacles on each side," "nostril with a tube," &c. being quite misleading. In the more primitive forms (*Lagocephalus*) there are two nostrils on each side, situated in an oval nasal area, which overlies an internal nasal sac, exactly as in *Balistes*, *Triacanthus*, &c. From these we pass to fishes (*Spheroides*) in which the nasal area is raised up into a more or less prominent tubular papilla bearing the two nostrils, whilst the nasal sac is scarcely sunk below the level of the skin, and is in great part represented by the interior of the papilla, on the walls of which are the terminations of the olfactory nerve. By the absorption of the septum between the nostrils at the end of the papilla they become confluent, and we get a circular tube produced terminally into two more or less distinct lips or tentacles, in the more specialized of which the circular tube is short and constricted, so that we have two tentacles, on the inner surface of which are the terminations of the olfactory nerve, united basally. Thus when the nostrils become confluent the interior of the nasal sac is exposed, and in some species of *Tetrodon* it may be said to be raised above the level of the skin. In *Tropidichthys* the circular tube has degenerated to an inconspicuous rim with a minute aperture. In

Xenopterus and *Chonerhinus*, on the contrary, it has become excessively developed.

Dr. Gill (Proc. U.S. N. M. xiv. pp. 705-720, pl. xxxiv. (1890)) has arranged the fishes which I here include in the family Tetrodontidæ in three families: Tetrodontidæ, Chonerhinidæ, and Canthigasteridæ, which are chiefly distinguished by supposed cranial differences. In the Canthigasteridæ and Chonerhinidæ the post-frontals are said to meet in the middle line, thus separating the frontals from the supraoccipital. An examination of the skeletons has convinced me that in these fishes the post-frontals are confined to the sides, and that the frontals are in contact with the supraoccipital. The erroneous statements and figures of Hollard have met with too ready an acceptance, that author having mistaken ridges on and fissures in the frontal bones for sutures between them and the post-frontals. The Canthigasteridæ are also defined as having a long prominent

A Text fig. 58. B



A. Skull of *Tetrodon sceleratus*, seen from above (on the right the postero-lateral process of the frontal has been removed).

B. Skull of *Tropidichthys papua*, seen from above.

C. " " " side view.

pm., premaxillary; *m.*, maxillary; *pal.*, palatine; *eth.*, ethmoid; *prf.*, præfrontal; *f.*, frontal; *ptf.*, postfrontal; *sq.*, squamosal; *par.*, parietal; *eo.*, exoccipital; *so.*, supraoccipital.

ethmoid, in opposition to the Tetrodontidæ, with short or narrow ethmoid, not prominent. I find that in *Tetrodon lagocephalus*, *scleratus*, *lævigatus*, &c. the ethmoid is long, by no means narrow, and at least as prominent as in any species of the so-called Canthigasteridæ. The Chonerhinidæ are also separated on account of the increased number of vertebræ and dorsal and anal rays, but as in the Tetrodontidæ the vertebræ vary from 17 to 22 in number, and the dorsal rays from 6 to 19, it is scarcely logical to separate from them *Chonerhinus*, with 24 vertebræ and 25–26 dorsal rays, nor *Xenopterus* with 29 vertebræ and 32–38 dorsal rays, on that account alone.

The question as to how many genera it is convenient or useful to recognize in this family is a very vexed one. Perhaps, on account of the many strange and abnormal features which unite the Tetrodontidæ and distinguish them from more typical fishes, one is rather apt to overlook the differences which exist among them; nevertheless, it is very evident that many of the so-called genera are incapable of definition and cannot be maintained.

The genera *Ephippion*, *Tropidichthys*, *Chonerhinus*, and *Xenopterus* can be easily defined; but I am inclined to unite the remaining species in a single genus *Tetrodon*, as the differences in the structure of the skull and of the nasal organ show so many gradations that they can hardly be used for generic diagnoses.

In *Tetrodon psittacus* Bl. Schn. I find that the frontals extend to the orbital margins, therefore *Colomesus* Gill, if a valid genus, has not been correctly diagnosed.

Genera.

1. TETRODON Linn.—Body oblong or elongate, broad or somewhat compressed, prickly or smooth. D. 6–19. A. 6–17. Vertebræ 17–22. Præfrontals, frontals, and post-frontals with lateral expansions which form the orbital roof. Nostrils either separate or confluent.

2. EPHIPPION Bibr.—Differs in having the body armed with bony plates. Nostrils confluent. Skeleton unknown.

3. TROPIDICHTHYS Bleeker.—Body compressed. D. 8–10. A. 8–10. Vertebræ 18. Nostrils confluent, a single small aperture on each side. Ethmoid long, narrowed forwards. Posterior part of frontals with paired lateral crests.

4. CHONERHINUS Bleeker.—Differs from *Tetrodon* in that the dorsal and anal fin-rays are in increased number, as are the vertebræ (D. 25–26. A. 23–25. Vertebræ 24). The præfrontals small, without lateral expansions. The nasal organs are very similar to those of *T. patoca*, but developed into a large funnel-shaped rim.

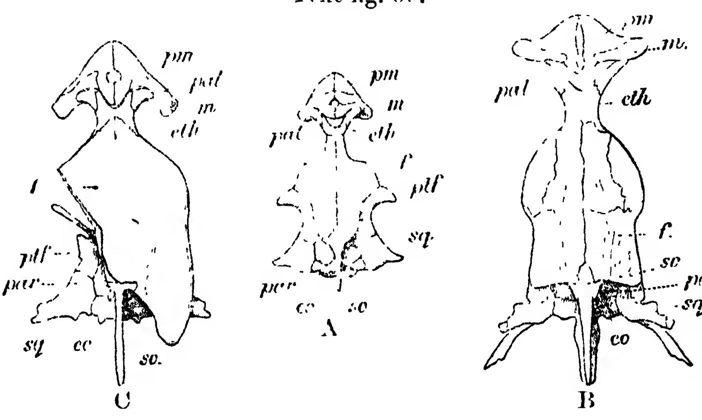
5. XENOPTERUS Hollard.—Differs from *Chonerhinus* in having more vertebræ and dorsal and anal rays (Vertebræ 29. D. 32–38.

A. 28 32), whilst the frontals have large postero-lateral expansions, completely roofing-in the post-frontals, which are invisible from above.

[Since the reading of this paper I have been in communication with Dr. Pellegrin of the Paris Museum, who has examined the skeleton of *Xenopterus bellangeri* described by Hollard, and also the spirit-specimens referred to that species. These latter he is unable to distinguish from *X. naritus* Richardson; but the skull figured by Hollard differs considerably from that of *X. naritus*, and, unless these differences should prove to be sexual, must be regarded as belonging to a distinct species, although the number of vertebræ (29) and of fin-rays (D. 34, A. 29) are the same in each case.

In *X. bellangeri* the frontals are scarcely thickened, they show lines resembling sutures, corresponding to similar lines in *Chonerhinus modestus* Bleeker, and due to the texture of the bone, and

Text-fig. 59.



Skulls of (A) *Chonerhinus modestus*, (B) *Xenopterus bellangeri*, and (C) *Xenopterus naritus*, seen from above, in the latter the left postero-lateral extension of the frontal has been cut away. Lettering as in text-fig. 58.

their postero-lateral expansions do not extend over the parietals and squamosals. *X. naritus* differs in having very thick frontals, without any trace of lines of ossification and even the median suture obscure, and with strong postero-lateral expansions roofing-in parietals and squamosals.

Through the kindness of Dr. Pellegrin, to whom I take this opportunity of expressing my gratitude for the trouble he has taken, I am enabled to reproduce a drawing of the skull of *X. bellangeri* already figured by Hollard, for comparison with those of *X. naritus* and *Chonerhinus modestus*. Hollard's skeleton must be regarded as the type of *X. bellangeri*; it is 280 mm. in total length.—*Dec.* 20, 1902.]

Family 2. DIODONTIDÆ.

All the præcaudal vertebræ with bifid neural spine; anterior caudals with bifid divergent hæmal spines instead of closed hæmal arch. Behind the dorsal and anal fins the neural and hæmal spines are single, but bifurcate distally. Teeth in the jaws coalescent, forming a beak without median suture; internal dentigerous plates well-developed. Interoperculum rod-like, attached posteriorly to the rod-like anterior limb of the suboperculum. In other characters essentially similar to the Tetrodontidæ, but with a less strongly ossified skeleton and larger dermal spines.

I am inclined to think that only two genera are capable of clear definition: DIODON, corresponding to *Diodon*, *Chilomycterus*, *Dicotylichthys*, and *Atopomycterus* of Günther's Catalogue, of which *Trichodiodon* and *Trichocyclus* are probably young forms; and LYOSPHÆRA.

The skeleton is in all exactly similar, and the differences in the nasal organs are not well marked, as although some species have a tubular papilla with two nostrils, others a two-lipped tube, in many of the former the septum between the nostrils is so easily and so often torn that the condition in the latter results. Also those species with two-rooted movable spines are connected with those with three-rooted fixed spines by a series of species with both sorts of spines in varying proportions.

Genera.

1. DIODON Linn.—Body stout, with strong spines. Nostrils in a tubular papilla, sometimes confluent. D. 10–15. A. 10–15. Vertebræ 21 or 22. Frontals much expanded. Post-frontals in contact with supraoccipital, separating parietals and frontals.

2. LYOSPHÆRA Evermann & Kendall.—Body oblong ovoid, covered with feeble spines attached to papery plates. Caudal peduncle very short. Two nostrils in a tubular papilla. D. 11. A. 4.

Family 3. MOLIDÆ.

Præcaudal vertebræ without parapophyses; anterior præcaudals with divergent bifid neural spines and neural canal not roofed in; no epipleurals. Præorbital not ossified; no distinct bony nasal cavity; palatine firmly united to the skull; præmaxillaries not protractile, firmly united to the maxillaries; teeth in the jaws coalescent, forming a beak without median suture; palate toothless; fourth upper pharyngeals present, toothed; lower pharyngeals separate; interoperculum rod-like, attached posteriorly to the rod-like anterior limb of the suboperculum. Two nostrils on each side. Gills four, a slit behind the fourth; pseudobranchiæ present [1]; six branchiostegals, the first not enlarged. Skin

[1] The "accessory opercular gill" of so many authors is only a well-developed pseudobranch.

rough or tessellated. Body truncate posteriorly, without caudal peduncle. Caudal fin absent, the dorsal and anal fins confluent posteriorly. Skeleton moderately ossified. Air-bladder absent.

Genera.

1. MOLA Cuv.—Body ovate, compressed; skin thick, rough. Vertebræ 17.

2. RANZANIA Nardo.—Seems chiefly different from *Mola* in having the body covered with small hexagonal juxtaposed plates.

PART II.

Notes on some Plectognathous Fishes, and Descriptions of some new species in the British Museum Collection.

In these descriptions the length of head is measured from the tip of the snout to the upper end of the gill-opening, the depth of body at the level of the vent, the movable pelvis or inflatable belly making the measurement of the greatest depth uncertain.

BALISTES NAUFRAGIUM Jordan & Starks.

In descriptions of this species a feature of some importance has been overlooked, *i. e.* that the scales on the cheeks are arranged in parallel horizontal series, with naked lines intervening between those in front of the pectoral, and although closely allied to *Balistes capriscus* Linn. it is still closer to *B. flavimarginatus* Rüpp., and should have been placed in the genus *Xanthichthys* recognized by the authors who named it.

Incidentally this species demonstrates of what little value are genera based on features so trivial as those supposed to separate *Balistes* from *Xanthichthys*.

BALISTES CASTANEUS Richardson.

This species, described by Richardson in the 'Voyage of the Sulphur, Fishes' (p. 126, pl. 59), has been included by Günther in the synonymy of *Balistes capriscus* Linn., from which it differs in many ways, and I therefore take the opportunity of redescribing Richardson's type specimen.

Depth of body twice in total length, length of head 3 times. Snout 3 times as long as the eye-diameter, which is $\frac{2}{3}$ of the interorbital width, which is less than $\frac{1}{3}$ the length of head and equal to the length of the gill-opening. A groove below the nostrils; 2 or 3 enlarged plates behind the gill-opening. D. III, 28. A. 26. The first dorsal spine above the gill-opening, with about 8 vertical rows of minute tubercles anteriorly, somewhat curved, its length $1\frac{2}{3}$ times in the length of head; second and third spines prominent; soft dorsal somewhat elevated anteriorly, the fifth ray the longest, longer than the first dorsal spine. Anal similar, but not so deep. Caudal truncate, with the outer rays slightly produced. Scales on the cheeks in oblique series without naked lines intervening, on the caudal peduncle not bearing

spines or tubercles. About 70 in a longitudinal series from the gill-opening to the caudal, about 20 in an oblique series from the base of the pectoral to the vent, and about 50 in an oblique series from the origin of the dorsal to the ventral spine.

Yellowish-brown, with darker dots and points on the body and fins. Lips white, with a semicircular white fold behind them on each side.

Pacific. Total length 135 mm.

Balistes capriscus has rather larger scales, and in a specimen of the same size the eye-diameter is about $3\frac{2}{3}$ times in the length of snout, $1\frac{3}{4}$ times in the interorbital width, and there are also other differences.

PSEUDOMONACANTHUS PUNCTULATUS, n. sp. (Plate XXV. fig. 2.)

Depth of body $2\frac{1}{4}$ times in the total length, length of head 3 times. Snout nearly straight, but very slightly concave, about 4 times as long as the eye-diameter, which is $\frac{2}{3}$ of the interorbital width. Gill-opening $1\frac{3}{4}$ times as long as the eye-diameter, its upper and lower ends below the posterior and anterior margin of the eye respectively. D. II, 36. A. 32. Dorsal spine slightly in advance of the middle of the eye, with vertical rows of moderate-sized granules or tubercles anteriorly, the two rows on each side of the median row enlarged, but not forming distinct barbs; each lateral posterior edge with a row of conical tubercles (barbs) in its lower half; the length of the spine $1\frac{2}{5}$ times in the length of head. Second ray of spinous dorsal not prominent. Soft dorsal and anal similar, rounded, the longest ray $\frac{2}{5}$ the length of head. Pectoral as long as the gill-opening. Caudal rounded, half the length of head. Caudal peduncle deeper than long, with two pairs of small curved spines with points directed forward on each side. Ventral spine moderate, barbed. Scales represented by minute osseous granules.

Brown, with traces of numerous small darker spots on the sides. Caudal brownish, other fins immaculate.

Closely allied to *Pseudomonacanthus pardalis* Rüpp., which has a somewhat more declivous concave snout, tubercles on dorsal spine minute, slightly shorter head, narrower gill-opening, narrower interorbital space, &c.

A single specimen, 190 mm. in length, from Tahiti.

PSEUDOMONACANTHUS MULTIMACULATUS, n. sp. (Plate XXV. fig. 1.)

Depth of body $2\frac{1}{6}$ times in the total length, length of head 3 times. Snout slightly concave, about $3\frac{3}{4}$ times as long as the eye-diameter, which is $\frac{2}{3}$ of the interorbital width. Gill-opening $1\frac{1}{2}$ times as long as the eye-diameter, its upper and lower ends below the posterior and anterior margins of the eye respectively. D. II, 36. A. 32. Dorsal spine in advance of the middle of the eye, $1\frac{1}{4}$ times in the length of head, armed almost exactly as in the preceding species, but with the anterior double row of

enlarged tubercles more prominent. Soft dorsal and anal similar, rounded, their longest ray half as long as the dorsal spine. Pectoral scarcely longer than the gill-opening. Caudal rounded. Caudal peduncle deeper than long, with two pairs of barbs on each side as in the preceding species. Ventral spine moderate, barbed. Scales as minute granules.

Greyish, with rounded lighter (? light blue) spots on the sides of head and body. Upper part of head and body, above a line from the tip of snout to the eye and thence to the last dorsal ray, brown. Lower part of the body with a similar brown area. Fins immaculate.

A single specimen from Tahiti, 175 mm. in total length.

Very closely allied to the preceding species, differing chiefly in the more concave snout, more strongly armed dorsal spine, and colour.

PSEUDOMONACANTHUS DEGENI, n. sp. (Plate XXIV. fig. 1.)

Depth of body equal to length of head, 3 times in the total length. Snout slightly convex, about $3\frac{2}{3}$ times as long as the eye-diameter, which is equal to the interorbital width. Gill-opening about equal in length to $\frac{2}{3}$ the eye-diameter, its upper end below the hind margin of the eye. D. II, 34. A. 33. Dorsal spine above the hind margin of the eye, without barbs, its length $2\frac{2}{5}$ in that of the head; second spine scarcely visible. Soft dorsal and anal similar, rather elevated anteriorly, the rays increasing in length to the eighth or ninth, which is the longest and equal to half the length of the head, thence decreasing to about the twentieth, the rest subequal. Pectoral almost as long as the dorsal spine. Caudal rounded, more than half the length of head. Caudal peduncle longer than deep. Scales minute, shagreen-like. Ventral spine small.

Greyish, with blue spots on the sides of the head and anterior part of the body, and on the caudal peduncle. Some faint oblique blue lines on the sides between dorsal and anal fins. Fins green.

A single specimen, 190 mm. in total length, from Melbourne Market, Australia. Mr. Degen sent with the fish a drawing showing the colours when fresh.

This species is closely allied to *Pseudomonacanthus modestus*, Gthr., *ayraudi* Gthr., and *septentrionalis* Gthr., which it resembles in physiognomy and in the shape of the fins, but all these have distinct barbs on the dorsal spine.

TETRODON INERMIS Schlegel.

This species was considered by Günther to be a variety of the Atlantic *T. lævigatus*, and the descriptions of Schlegel and Day (Fishes of India, p. 701, pl. clxxx.) have not sufficiently pointed out the features which distinguish it from that species, the most noticeable of which are as follows:—In *T. inermis* the body is much broader and deeper in proportion to its length, there is no distinct lateral fold in the abdominal region, and the spines on

the belly are reduced to rows of granules; also the interorbital space is distinctly narrower, and the lateral line in that region much nearer to the supraorbital margin than in *T. lævigatus*.

TETRODON HYPSELOGENION Bleeker.

With this species Günther has confounded a quite distinct species from Australia, and Day another very different species from the Indian Ocean, both of which are described below.

TETRODON PLEUROGRAMMA, n. sp. (Plate XXIV. fig. 2.)

Tetrodon hypselogenion (part), Günther, Cat. viii. p. 277 (1870).

A moderately developed lateral fold on the posterior part of the body. Nasal papilla moderately elevated, with 2 nostrils. Body rather broader than deep; the length of head about 3 times in the total length; snout as long as wide, about $2\frac{1}{4}$ times in the length of head, eye-diameter $4\frac{1}{2}$ $5\frac{1}{2}$ times, interorbital width 6 7 times. The width of the ethmoid almost equal to that of the interorbital space, which is distinctly concave. The jaws subequal in height, with slightly concave cutting-edges, without distinct ridges at the sides of the median groove. Spines rather strong, thick-set, extending from the nostrils to the level of the hind margin of the pectorals on the back and sides, and from below the eye nearly to the vent on the abdomen. D. 9-11. A. 8-10, pointed, subequal in height, their longest rays about $\frac{3}{5}$ the length of head. Caudal truncate.

Dark brown above, with irregular white spots; a golden band on the sides usually bearing one or two longitudinal dark stripes and separated from the colour of the back by a dark longitudinal stripe, that of each side being connected across the back by two rather indistinct dark cross-bands, one behind the pectorals, the other through the base of the dorsal; 5 or 6 subvertical dark stripes on the cheeks; abdomen white; fins immaculate.

Australia. Total length 135 mm.

This species differs entirely from *T. hypselogenion* Bleeker in the colour, in the stronger and more numerous spines with a more restricted distribution, in the interorbital space being concave instead of nearly flat, and in the more elevated dorsal and anal fins with the rays in greater number (usually D. 10, A. 9, in *T. pleurogramma*, and D. 8, A. 7 in *T. hypselogenion*).

TETRODON BREVIPINNIS, n. sp.

Tetrodon hypselogenion, Day, Fishes of India, p. 702, pl. clxxxiii.

Body with very indistinct lateral fold. Nasal papilla moderately elevated, with 2 nostrils. Body considerably deeper than broad; length of head $2\frac{4}{5}$ times in total length; length of snout about $2\frac{1}{4}$ times in the length of head, width of snout $3\frac{1}{3}$ times, eye-diameter 4 times, interorbital width 9 times and equal to the width of ethmoid. Upper jaw smaller than lower, without distinct ridges at side of median groove, with slightly concave cutting-edges. Spines of moderate strength, rather wide set, on

all parts of the head, and on the body extending nearly to the dorsal fin on the back and to the vent on the abdomen and almost as far on the sides. D. 8, A. 7, pointed, with very short bases, the length of the base of the dorsal about 3 times in its height. Caudal weakly lunate.

Above, a dark brown network enclosing lighter rounded areas, sides yellow, abdomen white; some vertical stripes on the cheeks. Dorsal with about 4 obscure cross-bands. Caudal with about 7 vertical bands most distinct in its upper lobe.

Indian Ocean. Total length of the specimen described, from Celebes, 55 mm.

This species is easily distinguishable from *T. hypselogenion* Bleeker by the colour and the much more compressed body and narrower snout, and especially by the shortness of the bases of the dorsal and anal fins.

TETRODON OCELLATUS Linn.

To the synonymy of this species Gunther has added *Tetrodon fasciatus* McClelland and *Tetrodon bimaculatus* Richardson, both of which I find to be quite distinct species, and I therefore give diagnostic descriptions of both. The specimen of *Tetrodon ocellatus* in the British Museum Collection, described as a variety with white annular and vermiculated markings on the back, is correctly referred to this species, as in every other character it is exactly similar to the more normal specimens, such as are figured by Richardson, Zool. Sulphur, Fishes, pl. 58.

TETRODON MACCLELLANDI, n. sp.

Tetrodon fasciatus McClell. Calc. Journ. Nat. Hist. iv. 1844, p. 412, pl. xxi.

An indistinct lateral fold on the caudal peduncle. Nasal papilla rather short, with 2 nostrils. Body considerably deeper than broad; the length of head about 3 times in the total length; snout wider than long, its length about $2\frac{1}{2}$ times in the length of head, eye-diameter 6-8 times, interorbital width $2\frac{1}{2}$ (adult) to $3\frac{1}{4}$ (young) times, and $2\frac{2}{3}$–$3\frac{1}{3}$ times as wide as the ethmoid. Jaws subequal in height, without distinct ridges at the sides of the median groove, with slightly concave cutting-edges. Spines very small, close-set, extending from between the nostrils to the base of the dorsal on the back, and from below the level of the eye to the vent on the abdomen, these groups being connected by two bands of spines (sometimes incomplete), behind the eye and behind the pectoral. D. 17–19. A. 15–17, pointed, subequal in height, the longest ray more than half the length of head; caudal truncate.

In the young, alternate broad and narrow light cross-bands on the head and back in front of the dorsal, about 6 or 7 in number; the last dark band extending back horizontally on the caudal peduncle. During growth the light bands break up into spots and finally disappear. At all ages a dark ocellated spot at the

base of the dorsal, another on each side above the pectoral, and sometimes an obscure one at the base of the pectoral. Fins immaculate.

Shanghai, Chusan, and Ningpo. Total length 280 mm.

Tetrodon ocellatus is easily distinguished by its coloration, and by its much narrower ethmoid, fewer dorsal and anal rays (D. 14–15. A. 12–13), and by the spines extending forward only to between the eyes.

The name *fasciatus* is preoccupied by *Tetrodon fasciatus* Bl. Schn., founded on a short description and obviously incorrect figure of Seba, and not since recognized.

TETRODON BIMACULATUS Richardson.

Body without distinct lateral fold. Nasal papilla moderately elevated, with 2 nostrils. Body nearly as broad as deep; the length of head nearly 3 times in the total length; length of snout about $2\frac{1}{2}$ times in the length of head, its breadth less than twice, eye-diameter about 7 times, interorbital width $2\frac{1}{4}$ times, and about 3 times as wide as the ethmoid. Jaws subequal in height, without well-marked ridges at the sides of the median groove, and with slightly concave cutting-edges. Spines moderately strong, close-set, extending on the back from between the eyes nearly to the dorsal, and on the abdomen from below the level of the eyes to the vent; the snout, sides of head and body, and caudal peduncle naked. D. 13–14. A. 11–12, pointed, subequal in height, their longest ray nearly half the length of head. Caudal truncate.

Greyish above, white below; 11 or 12 dark transverse stripes on the head and back before the dorsal, the posterior ones becoming horizontal and running back on the caudal peduncle. A blackish spot on each side covered by the upper part of the pectoral, and another on the base of the pectoral.

Estuaries of Chinese rivers. Total length 140 mm.

This species is quite distinct from the preceding, with which Richardson considered it to be identical; and from *T. ocellatus* it is easily separated by its colour and by its much broader snout and ethmoid. Richardson's figure (Zool. Sulphur, Fishes, pl. 57) is excellent.

TETRODON PLEUROSTICUS Günther.

To the synonymy of this species should be added *Tetrodon fasciatus* Macleay, Proc. Linn. Soc. N.S.W. ii. 1878, p. 365, pl. x. The three dark spots on the sides described by Günther terminate the quite distinct dark transverse bands on the back noted by Macleay, and the cross band between the eyes is also present.

TETRODON FLUVIATILIS Ham. Buch.

To the synonymy of this species should be added *Tetrodon waandersii* Bleeker, Nat. T. Ned. Ind. v. 1853, p. 194 (*Arothron waandersii* Blkr., *Leiodon waandersii* Blkr.). A comparison of

small specimens of this species with Bleeker's type specimen has convinced me of their specific identity. The supposed difference in the nasal organs is non-existent, they might impartially be described either as a short tube with two terminal lips, or as two tentacles united basally, although the former phrase is more applicable to the smaller specimens, the latter to the larger, as might be expected from what we know of the evolution of these organs.

TETRODON PUSTULATUS Murray.

The nasal organs in this species are almost exactly similar to those of the closely allied *Tetrodon patoca*, which has been placed in a different section on account of supposed differences in these organs.

TETRODON BORNEENSIS, n. sp. (Plate XXIV. fig. 3.)

Nasal organ an elevated tube, very indistinctly two-lipped, with a single terminal aperture. Body rather compressed, with dorsal keel more or less distinct, the caudal peduncle twice as deep as broad and not longer than deep. Length of head about $2\frac{3}{4}$ times in the total length; snout not longer than broad, half the length of head; nasal organs midway between eye and end of snout; eye-diameter $3\frac{1}{2}$–$4\frac{1}{2}$ times in the length of head, interorbital width about $2\frac{1}{3}$ times; ethmoid very narrow. Jaws subequal in height, the upper somewhat projecting, with fairly well-marked ridges on each side of the median groove; cutting-edges concave. Spines small, numerous, extending on the head and body from the level of the nostrils to that of the vent. D. 11. A. 10, rounded, not elevated. Caudal rounded.

Dark brown above, lighter below. A light cross-band between the eyes is continued forward on each side from the eye through the nasal organ to the end of the snout, and a broader band runs back on each side from the eye to meet its fellow in the mid-dorsal line. Sometimes irregular bands or reticulations on the sides and caudal fin. Dorsal and anal immaculate.

Sarawak. Total length 70 mm.

EXPLANATION OF THE PLATES.

PLATE XXIV.

Fig. 1. *Pseudomonacanthus degeni* (natural size), p. 299.
2. *Tetrodon pleurogramma* (natural size), p. 300.
3. „ *borneensis* (natural size), p. 303.

PLATE XXV.

Fig. 1. *Pseudomonacanthus multimaculatus* (reduced to $\frac{7}{11}$), p. 298.
2. „ *punctulatus* (reduced to $\frac{7}{11}$), p. 298.

3. On the Transformations of *Papilio dardanus* Brown and *Philampelus megæra*; and on two new Species of South-African Heterocera. By Lt.-Col. J. Malcolm Fawcett.

[Received August 8, 1902.]

(Plate XXVI.[1])

1. Papilio dardanus. (Plate XXVI. figs. 6, 7, larva; 8, 9, 10, pupa; 11, head of larva; 12, 13, female forms of imago bred.)

Papilio dardanus Brown, Ill. Zool. p. 52, t. 22 (1776).

♂ = *merope* Cramer, Pap. Exot. vol. ii. p. 87, pl. cli. figs. A, B (1777).

♀ = *cenea* Stoll, Suppl. Cramer, p. 134, pl. xxix. figs 1, 1 *a* (1791).

♀ = a variety of *hippocoon* Fabricius, Ent. Syst. iii. 1, p. 38 (1793).

Description.—*Larva, early stage.* Head greyish green, body dark chocolate-brown dorsally, abdomen, legs and claspers greyish green; broad white lateral stripes above the spiracles, meeting across the back on the 2nd, 5th and 6th, and 10th somites. On 1st somite a pair of long filamentous horns or tentacles minutely serrated with very short bristles, a pair of very short horns on 11th somite, and on the 12th somite a pair of similar horns to those on 1st somite but shorter, all greyish green in colour. The larva presents, in this stage, a great resemblance to the droppings of a small bird.

Final stage. Head green, body pale bluish green dorsally, abdomen, legs and claspers greyish white. On first somite a pair of short yellow tubercles from between which the Y-like organ (which is crimson paling to grey at the tips) is protruded when the larva is alarmed. On anal somite a pair of paler yellow tubercles; on 3rd somite a pair of black "eye-spots" surrounded by a white iris, subdorsally; a dorsal series of pale blue spots on 3rd to 6th somites, one on each somite. A yellowish-white subspiracular line from 4th somite to the tubercles at the anal extremity; spiracles reddish.

The larva in this stage is very limaciform, the divisions of the somites being very indistinct, and the body being very smooth and velvety.

Feeds on *Toddalia lanceolata* Lamarck, nat. ord. Rutaceæ. The larva feeds very low down on the plant, almost on the ground. It is always on the old leaves, and is very difficult to find.

Pupa. Pale yellowish green dorsally, darker green along the abdomen and wing-cases, and being almost flat and much expanded laterally, it looks exactly like one of the leaves of the food-plant. The palpi-covers, instead of being divergent as in other species of *Papilio*, converge to form a point, thus simulating the

[1] For explanation of the Plate, see p. 307.

point of a leaf; the lateral margins form a yellowish ridge from head to anal extremity, and are much expanded laterally at the point where the wing-covers are broadest; a thin raised median line dorsally and ventrally helps to complete the resemblance, by its likeness to the midrib of a leaf.

Mr. G. F. Leigh, F.E.S., has given me the following information, and is, I believe, the only person who has bred *P. dardanus* from ova in Natal.

A specimen of the common form of the female in Natal (*P. cenea*, Pl. XXVI. fig. 12) was captured and placed in confinement, and laid 42 eggs, 37 of which pupated and produced 17 male and 20 female insects. The eggs are white, and are generally laid on the underside of a leaf, not more than two eggs being deposited on one branch; the larval stages occupied one month, and the pupal stage fourteen days.

The species is double-brooded, larvæ having been found in February and in May, and probably they may be found in other months as well.

It will be seen from this that the female (from which Mr. Leigh bred his specimens from the egg) was one of the form which was described by Stoll as *P. cenea*, this being the form of the female most commonly met with in the Durban district, and that which appears to mimic *Amauris echeria* Stoll. Among the female imagines that resulted, there were, besides this form, also specimens of a form of female near the form described by Fabricius as *P. hippocoon*, this being a rarer form of the female in Natal (Plate XXVI. fig. 13); this form differs from the typical form of *P. hippocoon* from West Africa mainly in having a larger area of white on the hind wing than the latter, being modified in imitation of its model *Amauris dominicanus* Trimen (a local race of the West-African *Amauris niavius* Linnæus), which is also distinguished from the West-African form by having a larger area of white on the hind wing.

The males also differ from West-African specimens of *P. dardanus* in having the black discal spots and the marginal lunules on the upperside of the hind wing coalesced into continuous black discal fasciæ, and in the discal band on the underside of the hind wing being tinged with rust-colour instead of fuscous; they were also, as a general rule, a good deal smaller.

Mr. R. Trimen records the South-African form as a distinct species under the name of *P. cenea* Stoll (South-African Butterflies, iii. p. 243. n. 313), while Professor Aurivillius (Rhopalocera Æthiopica, p. 465. n. 8) considers *P. cenea* to be a "forma geographica" of *P. dardanus*.

The species is subject to almost endless variation, the differences given above between the South- and West-African races being by no means constant, and it appears to the writer impossible to divide them except as subspecies or local races.

Family SPHINGIDÆ.

2. PHILAMPELUS MEGÆRA. (Plate XXVI. figs. 3, 4, larva; 5, pupa.)

Sphinx megæra Linnæus, Syst. Nat. i. p. 492. n. 19 (1758); Mus. Ulr. p. 358 (1764); id. Clerck, Icones, t. 47. fig. 2 (1759).

Philampelus megæra Walker, Cat. Lep. Het. B.M. viii. p. 179. n. 11 (1856).

Euchloron megæra Boisduval, Spec. Gén. Lép. Hét. i. p. 214 (1875).

DESCRIPTION.—*Larva.* Head green, body pale yellowish green, irrorated with minute black spots and strigæ; an indistinct pale subdorsal line, defined on the 1st, 2nd, and 3rd somites by fuscous lines, and on the remaining somites to the 11th by paired black spots at the junctions of the somites, and on the 11th somite by three triangular fuscous spots situated at the base of the horn. On 4th somite a pale greenish-white "eye-spot" defined outwardly by a black circle; a dorsal fuscous line from head becoming obsolescent on 5th somite; horn short and yellow; legs and claspers concolorous with the rest of the body; spiracles fuscous.

Before pupating the larva assumes a pinkish-brown hue (as shown in Pl. XXVI. fig. 4).

Feeds on common vine.

Pupa. Dark red-brown, profusely mottled with fuscous spots and strigæ, formed amongst leaves on the surface of the ground in a similar manner to those of species of *Chærocampa.*

The various larval stages are completed in about one month, and in February and March only fourteen days are passed in the pupal stage.

Mr. J. F. Quekett, Curator of the Durban Museum, who has reared examples of this species, and to whom I am indebted for these observations, informs me that the species is probably single-brooded, as he has never heard of, or come across, a second brood.

The perfect insect is not commonly met with at Durban, but may, perhaps, be sometimes overlooked owing to its superficial resemblance to the common *Chærocampa idricus* Drury, although the latter is a much smaller species.

Family EUPTEROTIDÆ.

3. RABDOSIA CLIO, n. sp. (Plate XXVI. fig. 2.)

DESCRIPTION.—*Male.* Head and thorax reddish brown; abdomen and wings pale ochreous brown: fore wing crossed by a broad dark postmedial fascia; veins whitish, defined inferiorly by some black irrorations; a marginal series of pale wedge-shaped (cuneiform) lunules formed by the junction of the pale lines defining the veins, their apices reaching the margin of the wing;

the extremity of the wing is darker beyond these lunules, and also near the base between veins 1 and 2: hind wing with marginal lunules similar to those on the fore wing but paler and more indistinct. Cilia red-brown.

The specimen figured was reared from a larva in Pietermaritzburg in 1899, but the notes on its transformations were subsequently lost.

Family NOCTUIDÆ.

Subfamily QUADRIFINÆ.

4. DERMALEIPA DASEIA, n. sp. (Plate XXVI. fig. 1.)

DESCRIPTION. – *Male*. Head and thorax reddish brown; abdomen scarlet below, fuscous above. Fore wing reddish purple-brown, much irrorated with darker brown especially along the costal margin; a short subbasal dark line; a straight outwardly oblique antemedial line defined with dark fuscous outwardly; reniform large and dark, ringed with fuscous; an outwardly oblique postmedial line defined outwardly by a dark fuscous line; an irregular submarginal line of minute black spots between the veins. Hind wing apically and outwardly scarlet, inwardly black, the abdominal margin being fringed with a lateral tuft of long ochreous hairs. Underside scarlet, reniform black.

Female. Fore wing similar to that of the male but paler; hind wing with the black inner area divided into a median patch and a short submarginal fascia, the latter not reaching the outer margin of the wing near the anal angle, as in the male; no lateral tufts of long hairs on the abdominal margins. Underside as in the male.

This species presents considerable analogy to the well-known Indian species *Lagoptera juno* Dalman; the coloration being somewhat similar, and the lateral tufts of long hairs on the hind wing of the male being identical. This moth is a day-flier, and the writer has taken both sexes flying in brilliant sunshine in the covert known as "the Town Bush" near Pietermaritzburg, Natal, at about 3000 feet elevation in January.

EXPLANATION OF PLATE XXVI.

Fig. 1. *Dermaleipa daseia*, male, p. 307.
2. *Rabdosia elie*, male, p. 306.
3. *Philampelus megæra*, larva, second last skin, p. 303.
4. Ditto. Full-fed, just before pupating.
5. Ditto. Pupa.
6. *Papilio dardanus*, larva, early stage, p. 304.
7. Ditto. Larva, full-fed.
8. Ditto. Pupa, dorsal view.
9. Ditto. Pupa, ventral view.
10. Ditto. Pupa, side view.
11. Ditto. Head of larva with tentacles protruded.
12. Ditto. Female form bred = *cenea* Stoll.
13. Ditto. Female form bred = var. of *P. hippocoon* Fabricius.

4. On a Collection of Mammals from Abyssinia, including some from Lake Tsana, collected by Mr. Edward Degen. By Oldfield Thomas, F.R.S.

[Received October 27, 1902.]

By the generosity of a gentleman interested in Abyssinia, Mr. Edward Degen was enabled, during the first half of the present year, to make a collecting expedition to Abyssinia, the resulting specimens being all presented to the National Museum. While in Abyssinia Mr. Degen was able to go to the little-known Lake Tsana, in the centre of the country, where, so far as I can ascertain, no mammals have ever been collected since the time of Rüppell.

As might have been expected, the mammals obtained at this locality prove to be of the greatest interest, quite a number of them being new, notably the fine Otter, the large Mungoose, and the Hare, while others, only hitherto obtained by Rüppell, form most valuable accessions to the Museum. The most noteworthy of these latter is the little "*Mus imberbis* Rüpp.," for which I have found it necessary to propose a new genus.

The donor is to be congratulated on the highly satisfactory results of Mr. Degen's trip, so far as the mammals are concerned, the more so as this group had of necessity to receive only secondary attention as compared with the magnificent collection of Fishes, from which Mr. Boulenger has described so many novelties.

1. Colobus abyssinicus poliurus Thos.

2 ♂. Dodgit, W. Shoa. 26 June, 1902.

2. Papio doguera Puch.

♂. Ahouillet, Kutai. 21 June.

3. Megaderma cor Peters.

Dried specimen. Dhar-Ala, Danakil Country. 25 January. "Found in this condition in a cave."

4. Scotophilus nigrita Schr.

♂ ♀. Harar. 10 January.

5. Crocidura doriana Dobs.

♂, 2 ♀ in skin, and ♂ in spirit. Addis Ababa. March and April.

"Caught in Legation Garden."

6. Genetta, sp. inc. (near *G. dongolana* H. & E.).

o. Bijo. 16 January.

7. Herpestes ichneumon L.

♂. Billen, near the Hawash River in Adal country. 31 January.

8. Herpestes galera mitis, subsp. n.

♂. Zegi, Lake Tsana, 4000 feet.

A small-toothed Abyssinian representative of *H. galera*.

Fur long and coarse. General colour dark chocolate-brown all over, above and below, almost without annulations, some of the hairs only having a faint and scarcely distinguishable whitish subterminal ring. Head, feet, and tail darker even than the body, the last-named gradually becoming black terminally. A few wholly white hairs mixed with the fur of the fore-quarters.

Skull about the size of that of the true Southern *H. galera*, therefore considerably smaller than in the Central and East-African subspecies *robustus*. General form similar, but the posterior palate decidedly narrower, and the bullæ much lower and less prominent. Teeth smaller throughout, especially the last premolars above and below and the first molars.

Dimensions of the type (measured in skin):—

Head and body 600 mm.; tail 330; hind foot (c.) 100.

Skull—basal length 95; condylar length (basal length of P.Z.S. 1882, p. 65) 100; zygomatic breadth 62·5; interorbital breadth 21; breadth of brain-case 38; mastoid breadth 40·5; palate length from gnathion 56; breadth of posterior palate 8.

Teeth—greatest horizontal diameter of p^4 10·8, m^1 9·1, m^2 5·8; of p_4 7·5, m_1 8·6, m_2 5·9.

Type. The specimen above recorded. B.M. No. 2.9.9.6.

This fine Mungoose is of about the same size as the true Cape *Herpestes galera*, though with smaller teeth, the large *H. galera robustus* of East Africa and the Upper Nile separating the two. No Mungoose of this group appears to have been hitherto recorded from Abyssinia.

9. Ictonyx, sp. inc.

♀. Addis Ababa, 8000 feet. 26 March.

10. Lutra capensis meneleki, subsp. n.

♂. Zegi, Lake Tsana, 4000 feet.

The Abyssinian representative of the Cape Clawless Otter.

Size very large; colour very strong and dark, deep chocolate-brown on the back, darkening anteriorly almost to black on the nape and crown, where it is indistinctly grizzled with white. Muzzle greyish white. Lips, cheek, and sides of neck sharply contrasted white. Ears brown, with prominently white edges. Chin and throat dull yellowish white; belly brown, little paler than the upper surface. Limbs and tail dark brown as usual.

Underfur of body all over, and notably of back, silvery white, the extreme tips only of the hairs brown. In true *L. capensis* the underfur is almost entirely brown.

Skull very broad and massive, larger and heavier in every way than a fine adult male skull from West Africa. Interorbital,

I have much pleasure in naming this distinct species after Mr. Degen, the collector of the present interesting series.

15. Mus albipes Rüpp.

2 ♂, 1 ♀. Addis Ababa. March, April.

This species is readily distinguished by its long tail from the other members of the group. Mr. Pease also obtained two specimens of it at Lake Zuai.

16. Mus spp.

3 ♂, 3 ♀. Addis Ababa. February to March.
2 ♂. Hawash R. March.
♂. Gubre, Godjam, 6000 feet. 9 May.
♂. Abulie, Kutai. June.

Besides the long-tailed, long-skulled *M. albipes*, there appear to be more than one species of the difficult *macrolepis-lateralis* group in the collection, but without further material, with flesh-measurements, it is impossible to distinguish them or make out what names they should bear. Several of Heuglin's names appear to belong to this group.

17. Leggada mahomet Rhoads.

♂. Addis Ababa. 5 April.

18. Arvicanthis abyssinicus Rüpp.

♂ ♀. Addis Ababa. March.
♂ ♀. Yah-Yah, Shoa. April.
4 ♂. Lake Tsana. May and June.
♂ ♀. Hawash R. February and March.
♀. Lake Zuai. March.

For all these Abyssinian Arvicanthes I provisionally use Rüppell's name of *abyssinicus*, with typical specimens of which some of them entirely agree. But on the one hand there may be more than one definable form among them, and on the other identification has to be made of quite a number of other names which have been given to members of the group. Thus *Meriones lacernatus* Rüpp. and *Mus ochropus* and *M. rufidorsalis* Heugl. are all evidently forms of *Arvicanthis*, and will have to be identified when further material is available. But the North Somali *Arvicanthis*, which has been identified with the East-African *A. neumanni* Matsch., is clearly distinct and is now described [1].

[1] Arvicanthis somalicus, sp. n.

A small pale species allied to *A. neumanni*.

Size markedly less than in the other members of the group. General colour pale sandy buff lined with brown, becoming more "pinkish buff" on the rump. No trace of a spinal dark line. Head paler, almost whitish, eye-rings and ears sandy fulvous. Under surface dull whitish, the hairs dark basally. Upper surface of hands and feet buffy white. Tail blackish above, dull fulvous on the sides and below.

Skull small, strongly built, with strongly-ridged supraorbital region.

19. PELOMYS HARRINGTONI, sp. n.

♂. Katchisa, Kutai, W. Shoa. 23 June.

General appearance of *P. dembeensis* above, but belly with three bright buffy lines.

Size about as in *P. dembeensis*, smaller than in *P. fallax*. Fur rather crisp; general hairs of back about 12 mm. in length, the longer hairs overtopping them by about 5–6 mm. General colour dark lined olivaceous, more distinctly greenish than in *P. fallax*. Sides paler, more fulvous and more heavily lined. Under surface white (the hairs white nearly to their roots), with three bright buffy yellow lines running down it, one median on the chest and upper belly, and two lateral, bordering the dark colour of the sides the whole length of the animal, from the upper lip down the neck, body, and front of hind limbs to the ankles. Head like body, indistinct yellowish spots above and below eyes. Ears brown, their basal hairs yellowish. Fore limbs grizzled olive externally, darkening to brown on the hands; white on the inner surface. Hind legs olive externally, white edged with yellow internally; feet grizzled fulvous and brown. Tail thinly haired, blackish above, dull yellowish below.

Skull comparatively small and slender; interorbital region narrow, finely beaded. Palatal foramina well open, not markedly narrowed posteriorly, their hinder end level with the anterior root of m^1; posterior edge of palate level with the middle of m^3.

Incisors narrower than in *P. fallax* and much less distinctly grooved, the groove in fact almost obsolete. Molars smaller and more delicate than in *P. fallax*, but with the same essential distinctions from those of *Golunda*. Inner tubercle of each lamina throughout larger, and middle one smaller than in *P. fallax*, so that the inner one is about three-fourths the size of the middle one or more, while in *P. fallax* the middle tubercle is always twice the breadth of the inner one.

Dimensions of the type, taken on the skin:—

Head and body 140 mm.; tail 90+ — (imperfect); hind foot (s. u.) (wet) 27·3; ear (dry) 15.

Skull: tip of nasals to back of frontals 25; greatest breadth 14·5; nasals 12·5 × 3·8; interorbital breadth 4·1; palate length from henselion 13·3; diastema 8·5; palatal foramina 6·6 × 2·2; length of upper molar series 6.

Type. ♂. B. M. No. 2.9.9.36.

The only described species allied to *P. harringtoni* is Rüppell's *Mus dembeensis*, considered by Mr. de Winton[1] (although with

Dimensions of the type (measured in the flesh):—

Head and body 133 mm.; tail 104; hind foot (s. u.) 23; ear 16.

Skull—greatest length 30; basilar length 26; greatest breadth 16; interorbital breadth 5; length of upper molar series 5·9.

Hab. Northern Somali-land. Type from Shuk, alt. 4000 feet.

Type. Old male. B.M. No. 97.12.3.9. Collected and presented by E. Lort Phillips, Esq. Many specimens examined.

[1] P. Z. S. 1901, p. 81.

remarks on its molar differences) as an *Arvicanthis*, but which I think is also more nearly allied to *Pelomys*. From that species *P. harringtoni* differs by its striped belly and smaller molars.

I have named this handsome and remarkable species, which is distinguished from all its allies by the brilliant striping of its under surface, in honour of Col. Harrington, the British Resident at Addis Ababa, to whose assistance all British travellers in Abyssinia are so much indebted.

With regard to the use of the name *Pelomys*, a genus of recent years synonymized with the Indian *Golunda*, I have come to the conclusion that after all the two forms may well be considered as generically distinct. Like as they are in external characters, and in skull and incisor structure, the molars of the two groups show such differences in detail that, combined with the different geographical distribution, I think it would be best to keep them apart. While the molars of *Pelomys* are of fairly normal murine structure, with subequal anterior accessory tubercles, m^2 and m^3 of *Golunda* have their antero-internal tubercles hypertrophied and their antero-external ones minute or obsolete, so as to give a peculiar oblique appearance to the teeth. In outline the latter are also broader, shorter, and less narrowed posteriorly. The teeth of *Golunda* have been well figured by Blanford[1] and those of *Pelomys* by Peters[2].

Even after the removal of *Golunda* it is by no means certain that *Pelomys dombeensis* and *P. harringtoni*, with their almost ungrooved incisors, ought to be considered as congeneric with *P. fallax*, but I do not care to separate them without seeing what representative forms occur in the intermediate countries.

20. Lophuromys flavopunctatus Thos.

2 ♂, 2 ♀. Addis Ababa, 8000 feet. February and March.
♂. Yah-Yah, Shoa. 18 April.

The type of this species, which was discovered by Sir W. C. Harris during his Mission to Shoa in 1843, was probably obtained at Ankober, about 100 miles N.E. of Addis Ababa.

As is usual in this genus, the bellies of these specimens vary considerably in the intensity of their yellowish suffusion, the two females being the most strongly coloured. The upper surfaces are also by no means uniform in tone.

21. Muriculus imberbis Rüpp.

o. Zige, Lake Tsana, 4000 feet. 1 June.

Muriculus, gen. nov.

Size very small; proportions about as in *Lophuromys*. Hind feet with the fifth digit short, though not quite so short as the hallux. Claws small, not markedly elongated.

[1] Mamm. Ind. p. 427 (1891).
[2] Reise Mossamb., Mamm. pl. xxxv. fig. 9 (1852).

Fur thick, close, and rather crisp, some of the hairs flattened, though not to be called spiny. Back lineated in the type species. Tail short, closely but finely hairy.

Skull stoutly built, rather like that of a small short-headed *Lophuromys*. Palatal foramina very long; posterior palate continued some way backward behind molars. Incisors narrow, smooth in front, markedly thrown forwards, so that even the tips of the upper ones do not curve backwards towards the throat. Molars strictly murine, without any marked characteristics. m^2 and m^1 each with a large antero-internal accessory cusp, and the former only with a small antero-external one.

Type. *Mus imberbis* Rüpp.

Some years ago, by the kindness of the authorities of the Senckenberg Museum, I had the opportunity of examining the type of Rüppell's *Mus imberbis*, and saw at once that it could not be assigned to any known genus. Now that a specimen has been secured by Mr. Degen I venture to give it a generic name.

In a general way *Muriculus imberbis* looks like a pigmy *Arvicanthis* or *Lophuromys*, and, while clearly not assignable to any known genus, is somewhat lacking in definitive generic characters, its projecting incisors being its most marked feature. Its whiskers are as abundant as usual, Rüppell's specimen having no doubt lost them accidentally, and it has a distinct dorsal black stripe down the posterior half of the spine. This stripe is not mentioned by Rüppell, but is present in the type, as I have personally noted.

In some ways this is the most interesting of Mr. Degen's captures, and fills an important lacuna in the National Collection of Muridæ.

22. PECTINATOR SPEKEI Blyth.

o. Las Mahan, Somali.

23. LEPUS, sp. inc.

♂. Marmasa, N.E. of Mt. Asebot. 25 January.
o. Miessa, S. of Mt. Asebot. 23 July.

Long-eared Desert Hares of the *L. æthiopicus* type, not satisfactorily determinable without further material.

24. LEPUS FAGANI, sp. n.

♂. Zegi, Lake Tsana, 4000 feet. 28 May.

"In scrub."—E. D.

A remarkably dark-coloured Hare, quite unlike any of the pale N. African species.

Size medium. General colour very dark for an African Hare, the general tone of the back approaching Ridgway's "mummy-brown"; the underfur with pale slaty greyish bases and buffy tips, the long hairs light for their basal and black for their

terminal halves, with a buffy or dark isabelline subterminal band. Under surface mostly dull sandy or buffy, with but little white; not sharply defined from the upper surface. Crown of head grizzled mummy-brown, like back, a large area round each eye whitish buffy. Ears of only medium length, their outer surface dark grizzled brown, with an inconspicuous patch of dull black behind their tips; fringe of long hairs on lower part of anterior edge, of shorter hairs along the posterior edge, dull sandy; inner surface brown proximally, sandy terminally. Nape-patch rather paler than "cinnamon-rufous." Fore limbs like nape-patch at elbows, becoming sandy buffy on the hands; feet also dull sandy buffy. Tail unfortunately wanting in the only specimen.

Skull stoutly built, with a long heavy muzzle; supraorbital wings unusually small and weak; anterior shoulders of zygomata large and prominent, the breadth across them exceeding the posterior zygomatic breadth; palatal bridge of medium breadth; bullæ decidedly small.

Upper incisors each with a deep but simple enamel indentation, corresponding about to no. xiii. of the series figured by Dr. Major[1]; the groove entirely filled up with cement.

Dimensions of the type, measured in skin:—

Head and body 510 mm.; hind foot 102; ear-opening (wet) 90.

Skull—greatest length 90·5; basilar length 68·8; zygomatic breadth 40·3; nasals, length diagonally 41, breadth 20; interorbital breadth 21, breadth across supraorbital wings 21·7; intertemporal breadth 10·7; palatal foramina 22×8·5; palatal bridge 7·4; antero-posterior diameter of bullæ 10·2.

Type. The specimen recorded above. B. M. No. 2.9.9.54.

This very interesting Hare differs widely from all the pale long-eared N. African Desert Hares, and is apparently the representative in Abyssinia of the *L. whytei* group of Nyasa and Central Africa, with which it somewhat agrees in cranial characters and in the proportions of its ears.

I have named it in honour of my friend, Mr. Charles E. Fagan, Assistant Secretary of the Museum, to whom Mr. Degen, like all other collectors making expeditions for the benefit of the National Museum, has been much indebted for assistance.

25. Procavia brucei somalica Thos.

Adult ♂ & young. Bijo. 16 January.

26. Orycteropus afer æthiopicus Sund.

Andota. May.

[1] Trans. Linn. Soc., 2nd ser. Zool. vii. p. 468 (1899).

5. Note on *Alces bedfordiæ*.

By Hon. WALTER ROTHSCHILD, M.P., F.Z.S.

[Received July 1, 1902.]

At the scientific meeting of this Society on June 17th a communication was read from Mr. H. J. Elwes, taking to task Mr. Lydekker for describing a new Elk from insufficient material (see P. Z. S. 1902, vol. ii. p. 104). I wish to point out to the Society that the characters by which species and subspecies of vertebrate animals are distinguished are much more constant as a rule than those of the Invertebrata, the study of which probably induced Mr. Elwes to make this communication. Therefore Mr. Lydekker, to my mind, was justified in describing *Alces bedfordiæ*, though I personally would only have given the new form subspecific rank. In support of the validity of this new Elk, I may say I knew of its existence eight years before Mr. Lydekker described it. I have in the Tring Museum a good series of this form in addition to the two types. Mr. Carl Hagenbeck has received considerable numbers of these horns, and many pairs have passed through the London horn- and feather-merchants' hands, which, being of the same type, prove the recently described form to be fully worthy of a name.

November 18, 1902.

Prof. G. B. HOWES, D.Sc., LL.D., F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of October 1902: -

The registered additions to the Society's Menagerie during the month of October were 169 in number. Of these 66 were acquired by presentation and 1 by purchase, 89 were received on deposit, and 13 in exchange. The total number of departures during the same period, by death and removals, was 140.

Amongst these special attention may be drawn to:—

1. A specimen of the Galapagan Barn-Owl (*Strix punctatissima*), deposited Oct. 11th, probably the first example of this rare Owl that has reached Europe alive.

2. Seven living examples of the Galapagan Land-Iguana (*Conolophus subcristatus*) from Seymour Island, Galapagos, deposited Oct. 11th.

The Barn-Owl and Iguanas were brought from the Galapagos along with a collection of Gigantic Tortoises, and deposited by the Hon. Walter Rothschild, M.P., F.Z.S.

3. A specimen of the Fringed Gecko (*Uroplates fimbriatus*) from Madagascar, deposited Oct. 25th by the Hon. Walter Rothschild, M.P., F.Z.S.

Dr. Henry Woodward, F.R.S., exhibited photographs of two Stags' heads and read the following extract from a letter written concerning them by Mr. D. Russell, Hon. Sec. of the Otago Acclimatization Society:—"The stag-heads will give you an idea of how the Red Deer of Europe (*Cervus elaphus*) thrive here. The herd that these heads are from numbers from four to five thousand, and has resulted from the turning out of six hinds and two stags in 1868. Of course, the country is in every way suitable for them, and they have lots of room in front of them to populate. Some of the carcases weigh from five to six hundred pounds. There are similar herds in several other parts of New Zealand as well as in our district."

Dr. Woodward also read the following abstract from the Annual Report of the Otago Acclimatization Society for the season ending March 31, 1902, on the same subject:—"The herd of Red Deer on the Morven Hills and adjacent districts is doing remarkably well. We are much indebted to Mr. C. Turnbull for a very valuable report on the herd from personal observations made by him in April of this year. Mr. Turnbull informs us that the deer have greatly increased in numbers and spread far afield since he saw them last some seven years ago, and that the food in the Deer-country has greatly improved of late years owing to the rabbits being much less numerous than formerly. Mr. A. E. Leatham, a visitor from the Home country, has also kindly sent to the Council a report on the deer in the Hunter Valley Mr. Leatham spent a month in the district, and found deer fairly numerous in all the valleys running into the Hunter Valley, some of the valleys being ten and twelve miles long. Thirty miles up the Hunter Valley, Mr. Leatham shot stags, and observed their tracks going still further afield. The outer fringes of the herd will now probably be on the slopes of the West Coast, where they will have unlimited scope to spread unmolested, and will afford good deer-stalking for any number of sportsmen in the future. Owing to the mild winter and early spring the stags this season were in fine condition and carried good antlers. Several were shot with carcases weighing from five to six hundred pounds each, and quite a number of the heads obtained had antlers from 40 to 46 inches long from tip to base, with a width of span up to 41 inches. Mr. Quin, of Tapanui, procured this year four young hinds and two stags from Mr. Chirnside of Victoria. These have been put down on the upper reaches of the Pomahaka River, where the country is suitable for their requirements."

Mr. J. L. Bonhote exhibited and made some remarks on four hybrid Ducks which he had bred in his aviaries during the past summer. The first specimen exhibited was that of a cross between the Indian Spot-billed (*Anas pœcilorhyncha*) and the Wild Duck (*A. boschas*), the male parent being a hybrid between these two species, and the female a pure-bred Wild Duck. The remaining three specimens from two broods represented a cross

between three species, viz., the Indian Spot-billed, the Wild Duck, and the Pintail (*Dafila acuta*); in each case both the parents being hybrids. In one instance the drake was a Spot-billed Mallard, and the duck a Pintail Mallard, and in the second instance the sexes were reversed.

In pointing out in what manner these crosses partook of their parent forms, Mr. Bonhote drew attention to the fact of the great tendency they showed to become white on the underparts, which he was inclined to believe was a sign of reversion to an earlier form, having regard to the numerous species of water-birds in which light-coloured underparts were a constant feature.

A water-colour drawing of a male Spot-billed and Mallard hybrid in eclipse plumage was also shown; and it was pointed out that in the winter plumage this individual closely resembled the Mallard, while in the eclipse plumage it showed greater evidence of the other parent.

Mr. Bonhote drew the following conclusions from his experiments, so far as they had at present been carried:

(i) Hybridism between three species of surface feeding Ducks is comparatively easy of attainment; hybrids between two species showing no evidence of sterility.

(ii) There is a marked tendency in the produce towards white underparts.

(iii) So far as can be judged, the Pintail is slightly dominant over the Mallard, and the Mallard over the Spot-bill.

(iv) The chestnut breast and spotted bill are the most dominant features of their respective species.

(v) In a hybrid one species may be dominant in the winter plumage, and the other parent in the eclipse plumage.

Mr. Oldfield Thomas exhibited a mounted male, and a female skull of the East African representative of the Bongo Antelope, recently described by him as *Boocercus euryceros isaaci*[1] on these specimens, which had been obtained by Mr. F. W. Isaac in the deep forest of the Eldoma Ravine, British E. Africa, and presented by him to the National Museum.

Mr. Thomas drew special attention to the horns of the female, which, in proportion to the size of the animal, were longer than those of the male. The measurements had been given in the paper describing the subspecies.

This was no doubt the animal to which reference had been made by Mr. F. J. Jackson in a letter read before the Society in 1897[2], when the horns of a female were exhibited at the Meeting and figured in the 'Proceedings,' although at that date the native statement that they belonged to a female was not credited, and they were supposed to be those of a male Bushbuck allied to the Inyala (*Tragelaphus angasi*).

[1] Ann. Mag. N. H. (7) x. p. 310 (1902).
[2] P. Z. S. 1897, p. 455.

No other member of the *Tragelaphinæ*, except the Eland, had horns in the female; and it was on this character that it was thought that the Bongo should constitute a genus—*Boocercus*[1]—distinct from *Tragelaphus*, in which the females were hornless.

It still remained to be verified that the true Bongo of West Africa had also horns in the female, no members of that sex having as yet come to Europe. But the males from the two localities were so similar that it seemed highly improbable that the females should differ in so important a character.

Mr. O. Thomas, F.R.S., exhibited, on behalf of Mr. Lydekker (who was unable to attend), the mounted skin of an adult male of the Peking Deer (*Cervus* [*Pseudaxis*] *hortulorum*), recently presented by the President and the Duchess of Bedford to the British Museum. Mr. Lydekker believed that an adult specimen of this fine stag had not hitherto been figured, and he therefore thought that a figure of the example now exhibited would be desirable in the Society's 'Proceedings.' The specimen was in the summer dress.

Dr. A. Smith Woodward, F.R.S., gave an account of some excavations for the discovery of early Pliocene mammalian remains which he had recently made near Concud, in the province of Teruel, Spain. The bones had proved to be very abundant in a bed of freshwater marl, but they were in a much more fragmentary condition than those found at Pikermi, in Greece. He had discovered evidence of the former existence of species of the genera *Hipparion*, *Rhinoceros*, and *Mastodon*, and of several small antelopes, and exhibited some jaws of the first of these genera.

Mr. F. E. Beddard, F.R.S., remarked as follows upon the birth of an Indian Elephant in the Society's Gardens:—

The birth of an Elephant in a menagerie is so rare an event that some notice of the circumstances attending the birth of an Indian Elephant in the Society's Gardens in August last may prove acceptable to the Fellows. During the history of the Society there has been no other instance of an Elephant having been born in the Gardens; and in other menageries such occurrences are extremely rare. A note in the 'Field' newspaper of Oct. 25th last sums up the few births in menageries which have been recorded, and they are only two. The Elephant, which has lately given birth to a calf, was deposited in the Gardens on Sept. 19th, 1901, by Messrs. John Sanger & Sons. The Elephant was believed to be in young; but the exact date of impregnation was not known. There were reasons for believing that this took place in April 1900, and in that case the birth might have been expected to have occurred in January or February 1902. Mr. Arthur Thomson, the Society's Assistant Superintendent, reports

[1] *Euryceros* Gray *nec* Lesson.

that he examined the mother before she reached the Society's Gardens, and noticed some swelling of the breasts, but no other signs of approaching maternity. During the stay of the animal in the Gardens no further increase of size in the mammæ was observable; and, as there was no apparent increase of bulk in the abdominal region, the idea of pregnancy was abandoned. Dr. Thomas Stevens, of Guy's Hospital, was so good as to examine the animal; but he was unable to detect any obvious signs of pregnancy. However, on Sunday morning, the 31st of August, the animal produced a calf, the exact circumstances concerning the birth of which I subjoin from Mr. Thomson's report upon the matter:—

"On my arrival at the Elephant-house about 9.15 I stopped to look at the Elephant. I could see at once by the way she was walking about the den, sometimes forward and sometimes backward, and every now and then stooping with her hind legs and

Text-fig. 60.

Newly-born dead Indian Elephant, ♀.

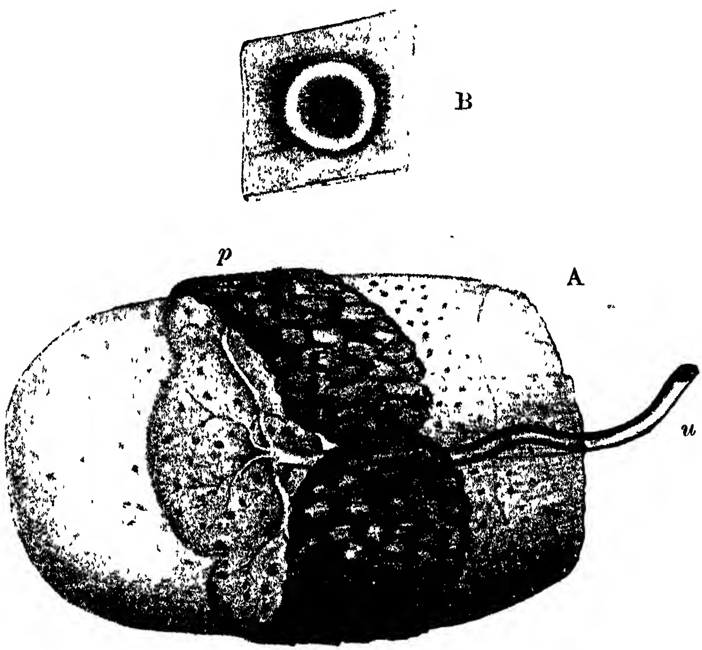
(From a photograph by Mr. W. P. Dando, F.Z.S.)

straining very much, that a young Elephant would soon be born. The keepers had all gone (as is usual on Sunday mornings), and I left the house to seek assistance and to send for the keepers. On my return about 9.45 A.M. the young Elephant had been born, and was lying dead in the middle of the den. I had the mother chained up, and then with the greatest care removed the dead animal, with the placenta, just as I found it, to the dead-house. The mother was very quiet, and did not in any way

attempt to interfere with the keepers whilst they were removing the dead young one."

Mr. Thomson came at once to my house and informed me of the fact. Unfortunately it was Sunday, and my assistant was away upon his annual holiday. I was therefore obliged to abandon the idea of taking out the fresh brain, which would have been of the greatest use. Mr. Thomson made the useful suggestion that the young animal should be photographed, and Mr. Dando, F.Z.S., accordingly took an excellent photograph of it, which is exhibited herewith (text-fig. 60, p. 321). I

Text-fig. 61.



Placenta of newly-born Indian Elephant, ♀.

A. General view of placenta (*p*) and membranes; *u*, umbilical cord.
B. "Subcircular body."

communicated with Dr. Stevens, who kindly came up to my laboratory, and we together examined the placenta, and also ascertained that the calf had been born dead; that it had never breathed was shown by the absence of air in the lungs, which sank in water. The measurements of the calf were as follows:—From front of forehead to root of tail 3 ft. 9 in.; height at centre of back 2 ft. 11 in.; angle of mouth to tip of trunk

1 ft. 10 in.; circumference of fore foot 1 ft. 8 in. The calf was a female, and the most noticeable external characteristic was the large amount of hair upon the body, particularly upon the limbs. The macroscopic features of the Elephant's placenta are known; but the following notes with which Dr. Stevens has furnished me are of value, since the opportunities of studying this organ have not been many:—

1. It is typically *zonary*, consisting of a belt of placental structure, approximately 10 inches in breadth on an average. Some parts were wider than others, and in places, being torn, there was a difficulty of estimation. The belt was divided into three chief masses as shown in the rough diagram (see text-fig. 61, A, p. 322). The greatest thickness of the placental tissue was $1\frac{1}{2}$ inches.

2. The placental tissue was somewhat broken up into cotyledons, as one finds in the human placenta.

3. The cord, 40 inches long, was inserted mainly into one placental mass, and from this point large vessels radiated under the amnion to the other placental masses.

4. There were two arteries and one vein in the umbilical cord. No obvious Wharton's jelly was present, only a dense connective tissue around the vessels and not much of that.

5. The membranes were torn at one end, where the fœtus escaped, but the other end of the amniotic cylinder was intact.

6. Scattered all over the membranes and in the substance of the amnion were the "subcircular bodies" (*Owen*) (text-fig. 61, B, p. 322)—most numerous near the placenta, least so at the extremities of the amniotic cylinder. These bodies are somewhat like buttons in appearance, with an elevated rim and a depressed centre. Microscopically they consist of fibrous tissue devoid of structure, and showing no nuclei or cellular contents.

The following papers were read:—

1. Note on the Markhor of Cabul. By R. LYDEKKER.

[Received October 10, 1902.]

(Plate XXVII.)

In my work entitled the 'Wild Oxen, Sheep, and Goats of All Lands,' I was unable to give any description of the Cabul race of the Markhor (*Capra falconeri megaceros*), save such as may be gathered from the skull and horns, for the very sufficient reason that I had never seen any other part of the animal. Recently the British Museum has acquired the skin, in the winter coat, of a remarkably fine male of this race, shot by a British officer in Chitral. The horns are essentially those of the Cabul race, being intermediate in form between the Pir-Panjal

and the Suleman types. In size the animal is fully equal to the typical Astor race of the species. The general colour is, however, decidedly darker, the tips of the hairs being blackish brown instead of a kind of blotting-paper colour. The throat-fringe seems also to be somewhat darker; and the under-parts show a decided difference from those of the Astor race, being at least as dark as, if not actually darker than, the back, instead of distinctly lighter. The resemblance between the two animals is, however, so close as to indicate without doubt that they are races rather than species.

It may be worth mention that the rocks of Chitral are gneiss, and these present a spotted black-and-white coloration very similar to that of the Cabul race of the Markhor, the name Chitra' itself not improbably being derived from these spotted rocks.

2. Second Account of the Fishes collected by Dr. W. J. Ansorge in the Niger Delta. By G. A. Boulenger, F.R.S., V.P.Z.S.

[Received October 15, 1902.]

(Plates XXVIII. & XXIX.[1])

In January 1901[2] I had the honour of reporting on a small collection of freshwater fishes made by Dr. Ansorge in Southern Nigeria. Small as it was, that collection proved to be of considerable interest, six species being new and one deserving to become the type of a new family (Phractolæmidæ). Encouraged by these results, Dr. Ansorge has continued to collect in the same district, and has enabled me to draw up the following list of 56 species not represented in his former collection; these, added to the 24 species enumerated in the previous list, make a total of 80. Four species are now described as new.

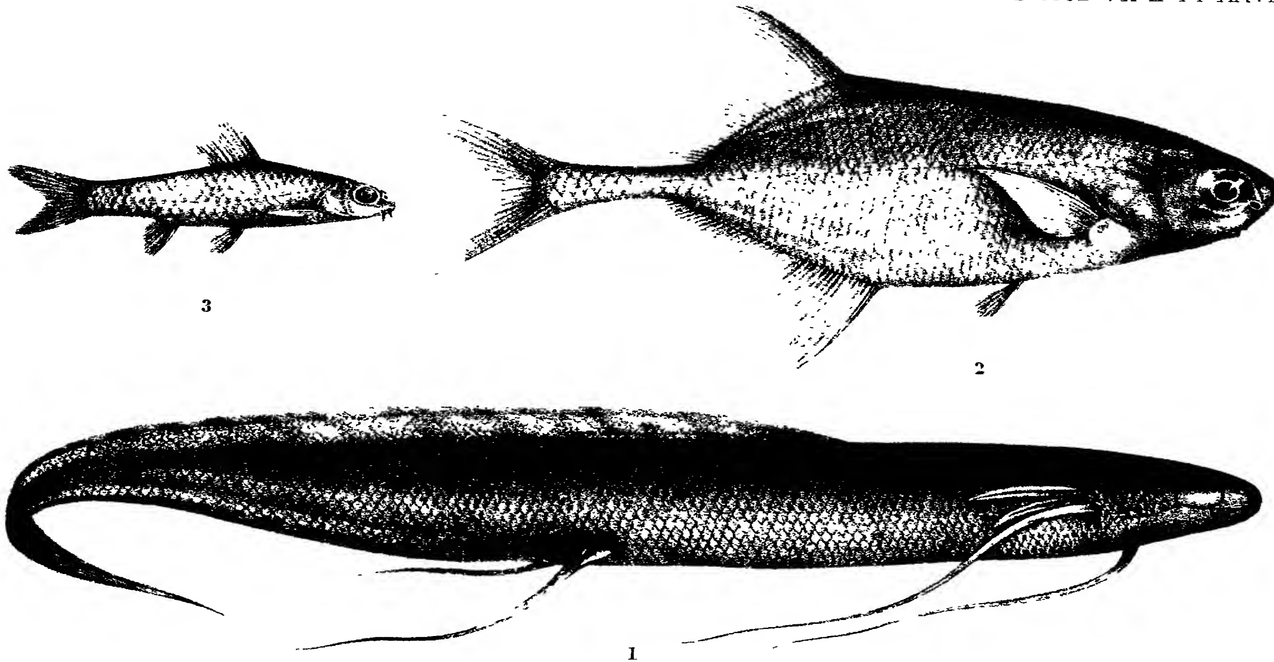
As on the previous occasion, the difficulty of procuring spirit in sufficient quantity has prevented Dr. Ansorge from preserving any but small specimens. The fishes here enumerated are either small species or are represented merely by young specimens. In the case of the *Polypteri*, which have already been described in these 'Proceedings'[3], there was no occasion to regret the course imposed on Dr. Ansorge by the circumstances.

Polypteridæ.

1. Polypterus lapradii Stdr.—Assay.

2. Polypterus endlicheri Heck.—Abo.

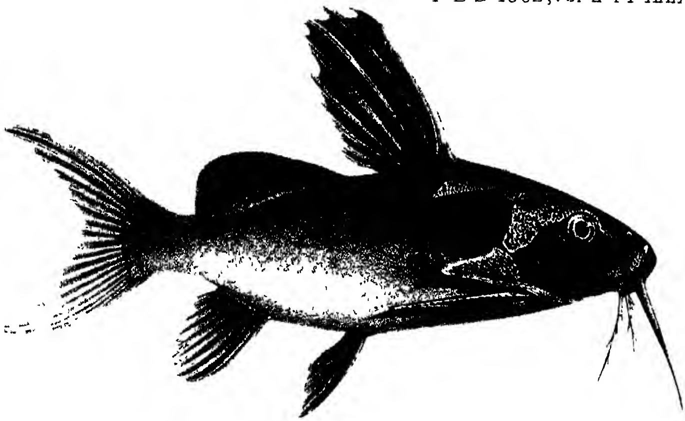
[1] For explanation of the Plates, see p. 330.
[2] P. Z. S. 1901, i. p. 4.
[3] P. Z. S. 1902, i. p. 121.



J. Green del. et lith.

Mintern Bros. imp.

1. PROTOPTERUS ANNECTENS 2. PETROCEPHALUS ANSORGII 3. BARBUS NIGERIENSIS



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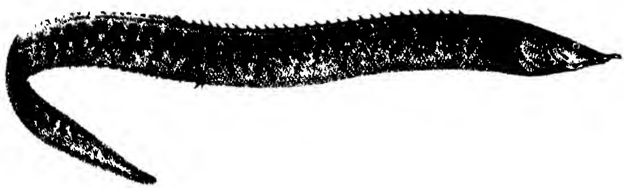

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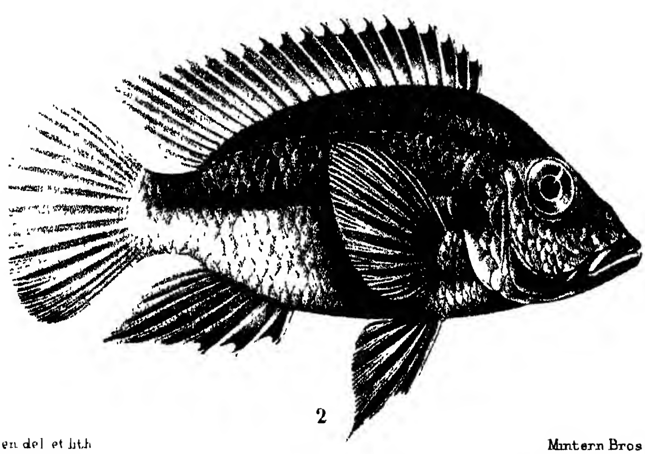


2

J Green del et lith

Mintern Bros imp

1 SYNODONTIS MELANOPTERUS 2 PELMATOCHROMIS PELLEGRINI
3 MASTACEMBELUS LOENNBERGI

3. Polypterus senegalus Cuv.—Assay, Abo.

The young specimens of these three species obtained by Dr. Ansorge have been described and figured in P. Z. S. 1902, i. p. 4, pls. x. & xi.

Lepidosirenidæ.

4. Protopterus annectens Owen. (Plate XXVIII. fig. 1.)

Three young specimens, 160 to 215 millim. long. The limbs are longer than in specimens of *P. æthiopicus* and *P. dolloi* of corresponding size, the fore limb extending to the vent, or beyond. Head $3\frac{2}{3}$ to 4 times in distance from end of snout to vent; eye 7 to 8 times in length of head, $1\frac{2}{3}$ to 2 in interorbital width. 50 scales in a longitudinal series from gill-opening to vent, 38 round the middle of the body. The longest external gills measure $\frac{2}{3}$ the length of the head. Vent on the left side in two specimens, on the right in the third.

The following are the measurements of the largest specimen:—

Total length 215 millim.; head 24; head to vent 70; head to origin of dorsal 30; fore limb 80; hind limb 56.

Mormyridæ.

5. Mormyrops deliciosus Leach.—Agberi, Assay.

6. Petrocephalus simus Sauv.—Agberi.

7. Petrocephalus ansorgii, sp. n. (Plate XXVIII. fig. 2.)

Depth of body 3 times in total length, length of head $4\frac{1}{3}$. Head slightly longer than deep; snout rounded, $\frac{1}{6}$ length of head; mouth situated below the eye, its width $\frac{1}{5}$ length of head; teeth bicuspid, 10 in the upper jaw, 20 in the lower; nostrils close together, close to the eye, a little above the level of its lower border; eye large, twice as long as the snout, $1\frac{1}{3}$ interorbital width. Dorsal 33, originating above 9th ray of anal, its length $1\frac{1}{2}$ in its distance from head. Anal 39, equally distant from base of ventral and from base of caudal. Pectoral pointed, $\frac{3}{4}$ length of head, twice as long as ventral and extending beyond base of latter. Caudal with pointed lobes. Caudal peduncle 3 times as long as deep, $\frac{2}{3}$ length of head. 45 scales in the lateral line, $\frac{11}{13}$ in a transverse series on the body, $\frac{14}{12}$ in a transverse series between dorsal and anal, 8 round caudal peduncle. Silvery, brownish on the back and on the anterior rays of the dorsal.

Total length 105 millim.

A single specimen from Agberi.

This species is well distinguished from all others of the same genus in having only 8 scales round the caudal peduncle. It approaches *P. bane* Lacép. in the number of dorsal and anal rays, but differs in the larger eye and the fewer teeth.

8. Marcusenius brachyhistius Gill.—Agberi.

9. GNATHONEMUS CYPRINOIDES L.—Agberi.

10. GNATHONEMUS PETERSII Gthr.—Oguta.

11. MORMYRUS MACROPHTHALMUS Gthr.—Agberi.

The type specimen of this species, registered as from "West Africa," came no doubt from the Niger, as I now find out through the association of the examples of other species received along with it.

12. HYPEROPISUS BEBE Lacép.—Abo.

13. GYMNARCHUS NILOTICUS Cuv.—Oguta.

NOTOPTERIDÆ.

14. XENOMYSTUS NIGRI Gthr.—Oguta.

CLUPEIDÆ.

15. PELLONULA VORAX Gthr.—Agberi.

CHARACINIDÆ.

16. HYDROCYON FORSKALII Cuv.—Assay.

17. ALESTES NURSE Rüpp.—Agberi.

18. ALESTES MACROLEPIDOTUS Cuv.—Agberi.

19. MICRALESTES ACUTIDENS Ptrs.—Agberi.

This species, described from Mozambique by Peters, has since been found in the Upper Niger by Dr. Christy, in the Ubanghi by Capt. Royaux, and in the White Nile by Mr. Loat.

20. NANNÆTHIOPS UNITÆNIATUS Gthr.—Abo.

21. DISTICHODUS BREVIPINNIS Gthr.—Agberi.

22. DISTICHODUS ROSTRATUS Gthr.—Agberi, Abo.

23. DISTICHODUS ENGYCEPHALUS Gthr.—Agberi, Abo.

24. CITHARIDIUM ANSORGII Blgr.—Abo.

This remarkable new generic type was described and figured in Ann. & Mag. N. H. (7) ix. 1902, p. 144, pl. iii.

25. CITHARINUS GEOFFROYI Cuv.—Agberi.

CYPRINIDÆ.

26. LABEO SELTI C. & V.—Agberi, Abo.

27. LABEO SENEGALENSIS C. & V.—Abo.

28. Barbus nigeriensis, sp. n. (Plate XXVIII. fig. 3.)

Depth of body equal to length of head, 4 times in total length. Snout rounded, projecting very slightly beyond the mouth, as long as the eye, $3\frac{1}{4}$ times in length of head; interorbital width $2\frac{2}{3}$ in length of head; lips indistinct; two pairs of barbels, the posterior as long as the eye, the anterior a little shorter. Dorsal III 8, last simple ray slender, flexible, a little shorter than the head; the fin, the border of which is scarcely emarginate, originates anteriorly to the base of the ventral and is nearer the occiput than the root of the caudal. Anal III 5, its longest ray $\frac{2}{3}$ length of head. Pectoral a little shorter than head, not reaching ventral. Caudal forked. Caudal peduncle $1\frac{1}{2}$ as long as deep. Scales 25 $\frac{3\frac{1}{2}}{3\frac{1}{2}}$, $2\frac{1}{2}$ between lateral line and ventral, 12 round caudal peduncle. Silvery, brownish on the back.

Total length 48 millim.

A single specimen from Agberi.

Allied to *B. camptacanthus* Blkr., but snout shorter, eye larger, and dorsal more forward in position.

29. Barilius niloticus Joannis.

Was obtained in the Upper Niger by Dr. Christy.

Siluridæ.

30. Clarias lazera C. & V.—Agberi, Abo.

31. Gymnallabes typus Gthr.—Ossomari.

32. Heterobranchus senegalensis C. & V.—Agberi.

33. Eutropius niloticus Rüpp.—Ossomari.

34. Schilbe senegalensis C. & V.—Abo.

35. Parailia congica Blgr.—Abo.

36. Chrysichthys buettikoferi Stdr.—Assay.

37. Clarotes laticeps Rüpp.—Oguta, Abo.

38. Auchenoglanis occidentalis C. & V.—Agberi, Assay, Oguta, Abo.

39. Synodontis gambiensis Gthr.—Assay.

40. Synodontis robbianus J. A. Smith.—Oguta, Abo, Ossomari.

41. Synodontis melanopterus, sp. n. (Plate XXIX. fig. 1.)

Præmaxillary teeth in several irregular series, forming a broad band; mandibular teeth 35 to 40, measuring about $\frac{2}{5}$ the diameter of the eye. Depth of body $3\frac{1}{2}$ times in total length, length of head $3\frac{1}{3}$ or $3\frac{2}{5}$. Head a little longer than broad, convex on the

occiput; snout obtusely conical, a little less than $\frac{1}{2}$ length of head; eye supero-lateral, $5\frac{1}{2}$ times in length of head, 2 in interorbital width; upper surface of head granulate and pitted from between the eyes. Occipito-nuchal shield as long as broad, simply convex, terminating in two pointed processes. Gill-cleft not extending below base of pectoral. Maxillary barbel distinctly fringed at the base, as long as the head; mandibular barbels with rather short, simple branches, the outer barbels twice as long as the inner and measuring $\frac{2}{5}$ length of head. Lips rather feebly developed. Humeral process granulate and feebly keeled, acutely pointed, extending as far as occipito-nuchal shield. Dorsal II 7; spine strong, shorter than the head, serrated behind. Adipose fin $3\frac{1}{2}$ times as long as deep, as long as the head, 3 times as long as its distance from the rayed dorsal. Anal III 8. Pectoral spine slightly shorter than the head, strongly serrated on the outer edge, more strongly still on the inner. Ventral reaching, or nearly reaching anal. Caudal deeply forked, with pointed lobes. Caudal peduncle as long as deep. Skin of body smooth. Dark brown above and beneath; fins black, with some light cross-bands in the young.

Total length 110 millim.

Two specimens from Oguta.

42. Synodontis membranaceus Geoffr.—Assay, Abo.

43. Phractura ansorgii Blgr.—Agberi.

P. Z. S. 1901, ii. p. 623, pl. xxxvii. fig. 1.

Cyprinodontidæ.

44. Haplochilus spilauchen A. Dum.—Degama.

45. Fundulus gularis Blgr.—Agberi.

P. Z. S. 1901, ii. p. 623, pl. xxxvii. figs. 2 & 3.

Polynemidæ.

46. Polynemus quadrifilis L.—Munanhor.

Serranidæ.

47. Lates niloticus L.—Agberi.

Cichlidæ.

48. Pelmatochromis pellegrini, sp. n. (Plate XXIX. fig. 2.)

Teeth in 2 or 3 series in each jaw. Depth of body $2\frac{1}{3}$ to $2\frac{2}{3}$ times in total length, length of head $2\frac{2}{3}$ to $2\frac{3}{4}$. Snout with straight profile, $1\frac{1}{2}$ to $1\frac{2}{3}$ diameter of eye, which is contained $3\frac{1}{2}$ to 4 times in length of head, and equals or nearly equals interorbital width; maxillary extending to about midway between

nostril and eye; 4 or 5 series of scales on the cheek; large scales on the opercle. Gill-rakers short and broad, 14 or 15 on lower part of anterior arch. Dorsal XVI-XVII 9–11; spines increasing in length to the last, which measures $\frac{1}{2}$ length of head; median soft rays more or less produced, $\frac{2}{3}$ to $\frac{4}{5}$ length of head. Anal III 7, third spine a little shorter than the last dorsal, median soft rays produced like the dorsals. Pectoral about $\frac{3}{4}$ length of head, not reaching origin of anal. Caudal rounded. Caudal peduncle as long as deep or a little deeper than long. Scales not ciliated, 28–29 $\frac{2\frac{1}{2}}{9}$; lat. l. $\frac{20\text{–}22}{9\text{–}11}$. Dark olive-brown above, yellowish beneath; a black opercular spot, followed by a rather indistinct dark band, extending to the root of the caudal; fins dark grey, spinous dorsal sometimes with a series of round black spots near the base.

Total length 135 millim.

Three specimens from Sapelle and one from Ossomari.

I have much pleasure in naming this fish after Dr. Pellegrin, of the Paris Museum, who is at present engaged on a monograph of the Cichlidæ, and who has pointed out to me the specific distinctness of this *Pelmatochromis* from *P. guentheri* Sauv., to which I had first referred it. The latter differs in the shorter posterior dorsal spines and the more truncate caudal fin.

49. Tilapia nilotica L.—Abo.

50. Tilapia galilæa Hasselq.—Agberi, Abo.

Pleuronectidæ.

51. Citharichthys spilopterus Gthr.—Degama.

52. Cynoglossus senegalensis Kaup.—Degama.

Gobiidæ.

53. Gobius nigri Gthr.—Degama.

54. Gobius schlegelii Gthr.—Agberi, Degama.

55. Gobius guineensis Peters.—Agberi, Assay, Abo.

G. æneofuscus, var. *guineensis* Peters, Mon. Berl. Ac. 1876, p. 248.

This is a smaller fish than the East-African *G. æneofuscus*, growing to a length of 75 millim. only. The interorbital space is narrower.

Recorded from the Cameroon River by Peters; obtained by Miss Kingsley at Kondo-Kondo, Ogowé; by Mr. G. L. Bates in the Benito River, Gaboon.

Mastacembelidæ.

56. Mastacembelus loennbergii Blgr. (Plate XXIX. fig. 3.) —Agberi, Abo, Oguta, Gregani.

Several specimens of this species, originally described from Cameroon. The largest measures 190 millim.

Depth of body 14 to 17 times in total length, length of head $8\frac{1}{2}$ or 9 times. Length of head 4 to $4\frac{1}{2}$ times in distance from snout to vent, $1\frac{1}{2}$ to twice as great as its distance from first dorsal spine; a præorbital and 2 or 3 præopercular spines. Dorsal XXVIII–XXXI, 110–130; anal II, 110–130. The coloration varies: some specimens are nearly uniform brown, with an ill-defined darker lateral band, others are spotted with darker or with lighter; a series of alternating dark and light bars may be present at the base of the anal fin.

EXPLANATION OF THE PLATES.

PLATE XXVIII.

Fig. 1. *Protopterus annectens*, young, p. 325.
2. *Petrocephalus ansorgii*, p. 325.
3. *Barbus nigeriensis*, p. 327.

PLATE XXIX.

Fig. 1. *Synodontis melanopterus*, p. 327.
2. *Pelmatochromis pellegrini*, p. 328.
3. *Mastacembelus loennbergii*, p. 329.

3. Last Account of Fishes collected by Mr. R. B. N. Walker, C.M.Z.S., on the Gold Coast. By Dr. A. GÜNTHER, F.R.S., V.P.Z.S.

[Received November 7, 1902.]

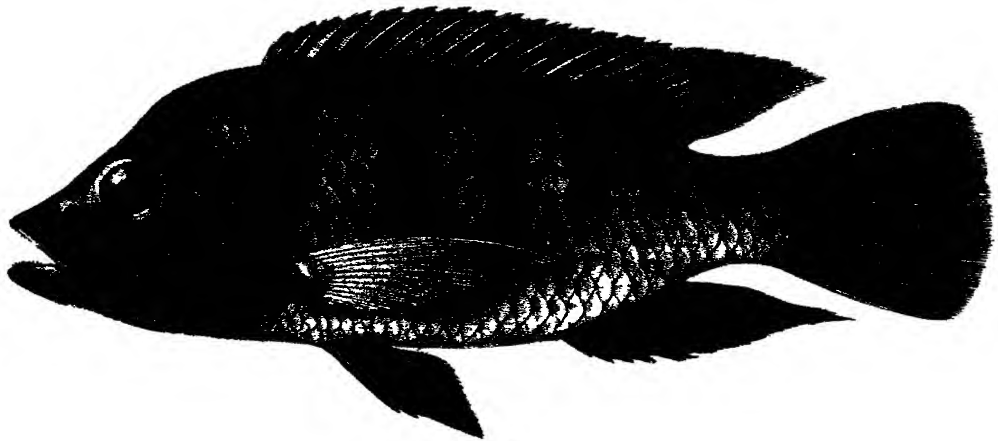
(Plates XXX.–XXXIII.[1] & Text-fig. 62.)

Shortly after the publication of my previous paper on Fishes from the Gold Coast (Proc. Zool. Soc. 1899, pp. 716–732), Mr. Walker paid another visit to that district. On this occasion he travelled into Ashantee, visited Lake Busum-chi, and followed the River Enon on a portion of his return journey. He did not long survive the fatigues of this, his last, voyage.

It was his intention to supply me with full particulars as regards the stopping-places at which he obtained the fishes; and I was all the more anxious to obtain this information, as some of the places are small and not important enough to be shown on any of the most recent maps of the country. Fortunately he was careful in labelling the bottles with the names and sometimes with the positions of the localities, although not always in a very legible manner; and supplementing this source of information with what I can gather from his letters, I am able to supply the following list:—

1. River Atesu,
2. River Ibbi, and

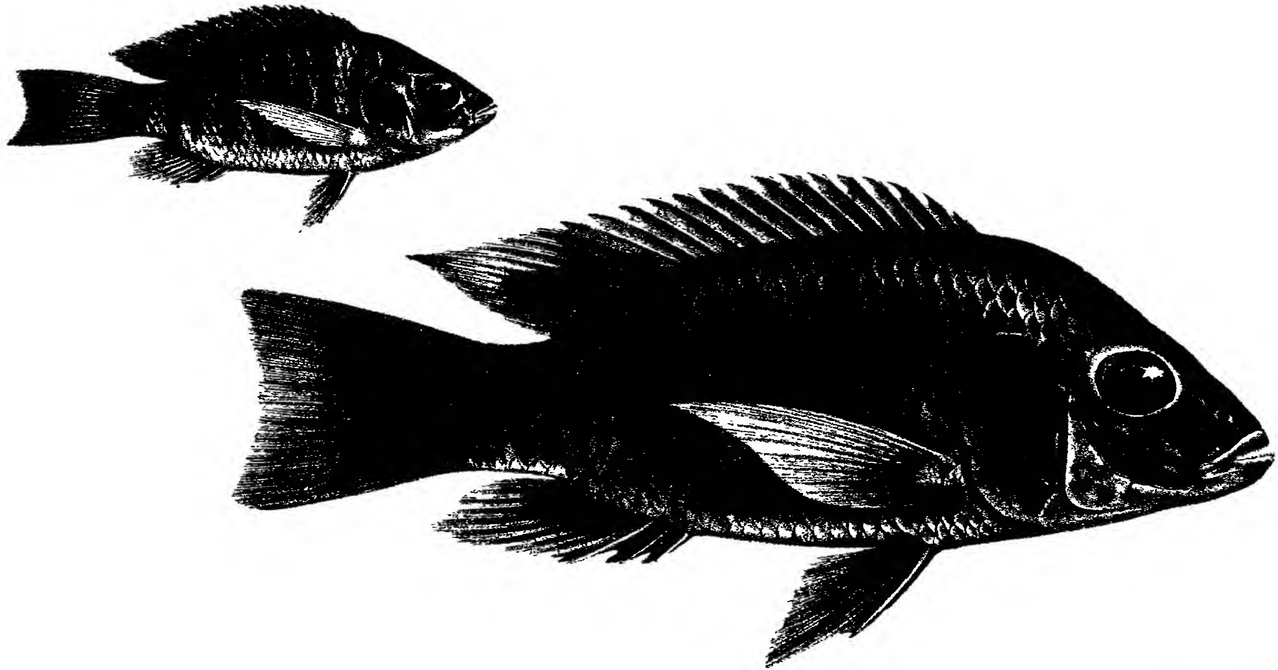
[1] For explanation of the Plates, see p. 339.



J. Green del. et lith.

CHROMIS BUSUMANUS

Mintern Bros imp



J. Green del et lith

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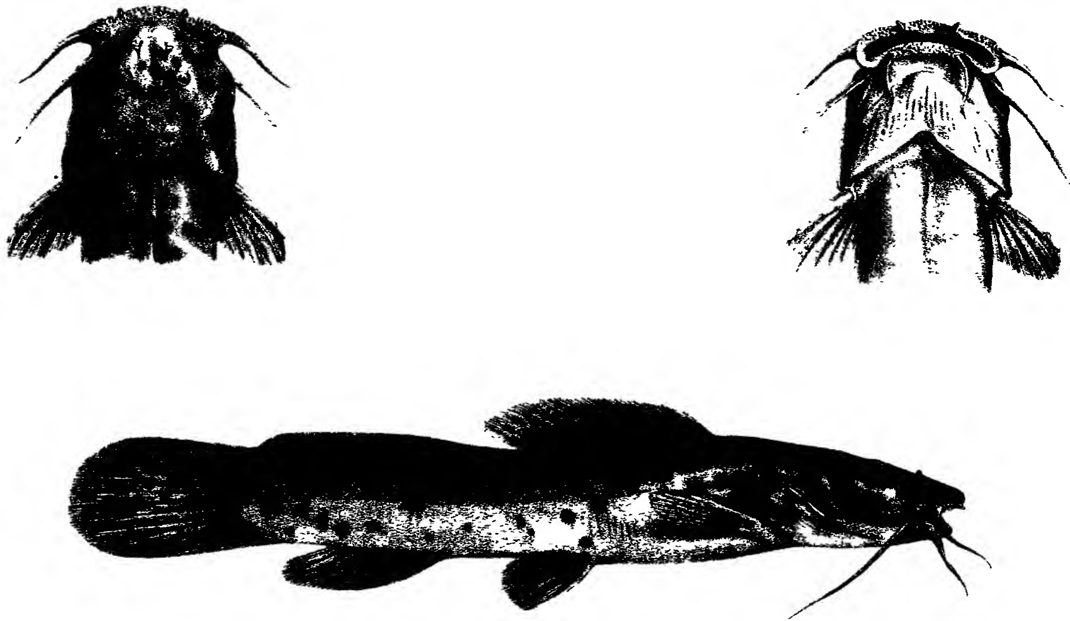
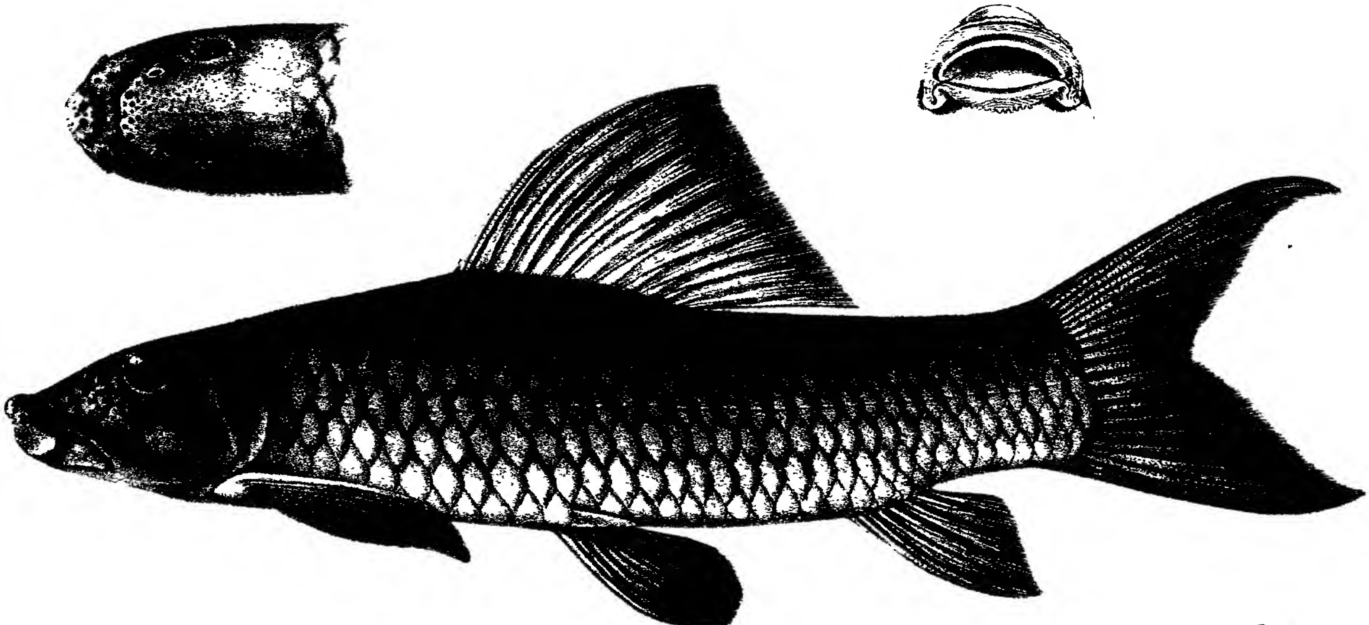
CHROMIS MULTIFASCIATUS



J Green del et lith. Mintern Bros imp

NOTOGLANIDIUM WALKERI



J Green del et lith

LABEO WALKERI

Mintern Bros imp

3. Bokitsa Mine– are two small rivers and a locality in the Wasa district.

4. Ingogosu is described on the label as a village in the mining centre of Kinkiankwâ.

5. Infoan, a small place on a tributary of the River Offim.

6. Dunkwa, a place on the River Offim or on one of its tributaries. Mr. Walker speaks of it sometimes as a place and sometimes as a river. There is another place with the same name north and inland of Cape Coast Castle.

7. Odumasi, a place on the upper part of the River Enon, east of Koumassi.

8. Lake Busum-chi.

9. Nyankoma, a place on the River Enon.

10. Town of Akropon.

Mr. Walker's connection with commercial affairs on the West Coast of Africa extended over a period of more than forty years, the greater part of which he resided in the country. It seems that the late Mr. T. Moore, Curator of the Liverpool Museum, was the first to interest him in making collections of Reptiles and Fishes. He retained this interest to the end of his life, much advancing our knowledge of the fauna of the Gaboon country and the Gold Coast; and there is no doubt that he would have accomplished still more if circumstances had permitted us to supply him with more ample means than were at his disposal, while, moreover, the primary objects of his pursuits demanded nearly all his time and energy.

CHROMIS OGOWENSIS.

Chromis ogowensis Gunth. Ann. & Mag. N. H. 1896, xvii. p. 271; Proc. Zool. Soc. 1899, p. 717.

This species is not to be united with *C. latus*, to which it has been referred by Boulenger (Proc. Zool. Soc. 1899, p. 125). In a smaller specimen of *C. latus* the anterior maxillary teeth are *absolutely* larger than, and the anterior mandibulary teeth as large as, the corresponding teeth of larger specimens of *C. ogowensis* [1]. The pectoral fin may be rather shorter or rather longer than the head; it generally does not reach the anal.

Mr. Walker's latest collection contains several additional

[1] In treating of the species of *Chromis* in the Congo, Mr. Boulenger (Poiss. du Congo, p. 453) states that for specific discrimination no reliance is to be placed on the number of teeth in the outer premaxillary series: first, because it varies "selon les individus," and secondly, because as a rule the teeth are relatively smaller and more numerous in adult than in young specimens. The first statement is opposed to my experience. There are broad-toothed and narrow-toothed species; but, of course, there is some variation even in the former, and the limits of variation widen in species characterized by small and numerous teeth, in which case it is not even desirable or useful to attempt to state the number of teeth. That young individuals have a smaller number than adult is true, as I also have already stated in Proc. Zool. Soc. 1896, p. 217, but this dental development cannot be called variation; with the advancing growth of the jaws more teeth are added laterally. I continue to

specimens of this species; he collected them on the River Dunkwa, and at Nyankoma, R. Enon.

Some of these specimens differ in certain points, as the height of the spinous dorsal fin, the form of the cheeks, &c., from those previously received and among themselves. However, I regard these differences as merely individual variations; they are indicated in the following table, in which measurements are given in millimetres; the teeth are counted on one side of the upper jaw only:—

Ch. ogowensis.	Total length.	Length of head.	Length of 8 D. spine.	Height of cheek.	Length of cheek.	Teeth in upper jaw.	Gill-rakers.	P. just reaching A.	P. not reaching A.
1. Lambarene, type	170	47	19	12	12	28	11+3	*	
2. Kotehwah R.	154	37	16	9	10	23	11+3		*
3. Prah R.	142	36	18	8	10	27	12+4		*
4. Prah R.	140	35	16	8	10	26	11+4		*
5. Kakum R.	162	42	20	10	13	29	12+5		*
6. Kakum R.	140	35	18	7	11	25	13+4	*	
7. Kakum R.	117	30	15	6	9	25	12+4		*
8. Dunkwa R.	130	32	17	7	10	25	11+4		*
9. Dunkwa R.	125	32	17	7	10	24	12+4	*	
10. Nyankoma	132	33	16	7	10	24	11+3		*
11. Nyankoma	129	33	16	7	11	26	12+5		*
12. *Ch. latus*, type	112	28	13	6	9	19	9+3		*

CHROMIS DISCOLOR, sp. n.

D. $\frac{15}{13}$. A. $\frac{3}{8}$. L. lat. 29–30. L. transv. 3/11.

Nineteen or twenty teeth on each side of the upper jaw. Maxillary rather short, not extending to the vertical from the front margin of the eye. Upper profile of the snout straight; interorbital space flat, wider than the orbit, which is nearly one fourth of the length of the head. Three series of scales on the

regard the size and number of teeth as a valuable specific character which should always be taken into consideration, combined with a statement of the size of the specimens to which the statement of the dental number applies.

Therefore I must demur to Mr. Boulenger's statement that in *C. ogowensis* the teeth "vary" from 15 to 30 on each side (*l. c.* p. 466). The typical specimen, from which alone my original description is taken, is 170 millim. long, and probably mature. The collector put into the same bottle two young specimens, 62 and 66 millim. long, which presumably may belong to the same species. I say presumably, for I confess that the uncertainty and difficulties attending the determination and specific discrimination of the young of closely-allied species of *Chromis* are too great to allow me to offer a categorical opinion upon them.

cheek. Form of the body rather oblong, its depth being contained $2\frac{1}{3}$ or $2\frac{1}{2}$ in its length (without caudal), and more than the length of the head. Gill-rakers of the outer arch twelve (4+8). Pectoral fin as long as, or even slightly longer than, the head, extending to the vent or origin of the anal. Ventral produced into a filament which may reach beyond the origin of the anal. The eighth dorsal spine is contained $2\frac{1}{2}$ or $2\frac{1}{3}$ in the length of the head. Caudal fin truncate, with the corners pointed. Scales cycloid. Colour variable: the whole fish may be brownish-black, the vertical and ventral fins and the base of each scale being deep black; or it may be of a uniform light colour, with some irregular black blotches on the opercle and throat.

Three specimens from Lake Busum-chi, measuring from 100 to 125 millim.

Chromis busumanus, sp. n. (Plate XXX.)

D. $\frac{15}{10}$. A. $\frac{3}{8}$. P. 13. L. lat. 29–30. L. transv. 3/11.

Scales cycloid, those on the cheek in three (two [1]) series. Teeth small, a few notched, in several series, from 24 to 28 on each side of the upper jaw; those of the lower jaw minute. Mouth rather small, the maxillary scarcely reaching the vertical from the anterior border of the eye. The depth of the body is *two fifths* of the total length (without caudal), the length of the head one third. Eye one fourth of the length of the head, two thirds of that of the snout, and rather less than the width of the interorbital space. *Nape of the neck more or less elevated, rendering the upper profile of the head slightly concave. Pectoral fin as long as the head*, extending nearly to, and sometimes even to, the origin of the anal. Caudal fin truncate or scarcely emarginate, with the corners rounded, or with the upper angular and the lower rounded, scaly at the base. The spinous dorsal fin rather low, the length of the eighth spine being about one third of that of the head. Gill-rakers of the outer branchial arch from 15 to 17 on the whole arch, or from 11 to 12 on its lower portion. Coloration uniform, or with six very indistinct cross-bands; operculum and dorsal fin with the usual black spot.

Total length 135 millim.

Several specimens from Lake Busum-chi.

Chromis multifasciatus, sp. n. (Plate XXXI.)

Allied to *C. macrocephalus* Bleek.

D. $\frac{15}{13}$. A. $\frac{3}{9}$. P. 13. L. lat. 28. L. transv. 3/11.

Scales cycloid, those on the cheek in two series. Teeth very small, in several series, notched, about 36 or 34 on one side of the upper jaw [2]; those of the lower jaw minute. Mouth small, transverse, the maxillary terminating at some distance in advance

[1] Three series in three species, in two others the third series is reduced to a single scale.

[2] Young specimens of about 70 millim. in length have a smaller number, viz. 28 or 30.

of the orbit. The depth of the body is contained $2\frac{1}{3}$ times in the total length (without caudal), the length of the head $2\frac{1}{3}$ or $2\frac{2}{5}$ times. Eye one fourth of the length of the head, and rather more than two thirds of that of the snout and of the width of the interorbital space; it is therefore a little nearer to the end of the snout than to the end of the opercle. Interorbital space transversely somewhat convex; upper profile of the head nearly straight. Pectoral fin as long as the head, extending to or beyond the origin of the anal fin. Caudal fin truncated, scaly at the base. Gill-rakers of the outer branchial arch from 24 to 26 on the whole arch, or from 19 22 on its lower portion [1]. Body with well-marked black cross-bands, eight or nine in number in young individuals, alternately deeper in colour and broader in width, the foremost (if distinct) being above the root of the pectoral fin, the second opposite to the fifth or sixth dorsal spine. In mature individuals the narrower cross-bands disappear, only five remaining, the last being across the root of the caudal. A large black opercular spot; sometimes a rounded blackish spot behind the last dorsal spine.

Total length	143	millim.
,, ,, without caudal ...	112	,,
Length of eighth dorsal spine ...	15	,,

Several examples from Lake Busum-chi.

CLARIAS KINGSLEYÆ, sp. n.

D. 79 87. A. 68. P. 1/9.

Vomerine teeth villiform, forming a horseshoe-like band, narrowed in the middle, its broadest part being as broad as the intermaxillary band; each half of the latter is not quite twice as wide as it is broad, and laterally scarcely extends as far outwards as the vomerine band. Head covered above with thick skin, two elevenths of the total length (without caudal), or nearly twice the distance from the origin of the dorsal fin. The width of the interorbital space is nearly one half of the length of the head. Barbels moderately long; the nasal nearly reaching to the gill-opening, the maxillary nearly to the origin of the dorsal fin, which is somewhat behind the end of the pectoral. Anal fin not low. No free space separating the caudal from the other vertical fins. Coloration uniform.

Total length 280 millim.

One specimen from Odumasi, another from Infoan on the R. Offim.

HETEROBRANCHUS ISOPTERUS Blkr.

Two specimens from Nyankoma and Infoan.

[1] As the branchial arch is in many of the species a segment of a more or less perfect circle, it is difficult to fix the boundary between its "lower," posterior or upper portion, and therefore it appears to be safer to count the gill-rakers of the whole arch, and not of a portion alone.

EUTROPIUS MENTALIS.

Eutropius congensis Günth. Proc. Zool. Soc. 1899, p. 730.
Eutropius mentalis Bouleng. Poiss. Congo, 1901, p. 269.

A dozen young specimens (5-7 in. long) were collected by Mr. Walker on the R. Offim. I believe them to be the same as a specimen of much larger size from the Prah River which, although it had its fin-spines mutilated, I referred to *E. congensis*. These young specimens do not quite agree among themselves as regards the comparative length of the barbels, but all have the nasal barbel considerably shorter than the maxillary or outer mandibulary one; and therefore I hesitate to refer them to *Eutropius mandibularis*[1]. The amount of variation in the length of the barbels within the limits of a species, and any change in this character dependent on growth, are quite unknown at present.

CHRYSICHTHYS WALKERI.

Chrysichthys walkeri Günth. Proc. Zool. Soc. 1899, p. 720.
One specimen, R. Offim.

CHRYSICHTHYS LAGOENSIS. (Text-fig. 62, p. 336.)

Chrysichthys lagoensis Günth. Proc. Zool. Soc. 1899, p. 725.
One specimen, Nyankoma.

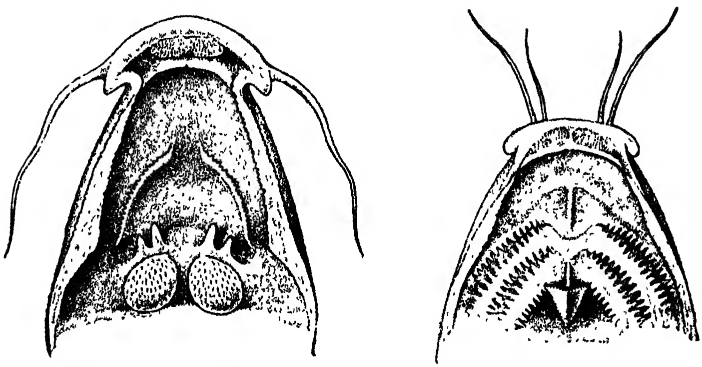
This specimen is a male 177 millim. long. It presents a peculiar modification of the integument of the buccal cavity, which I have also observed in other specimens of this genus, in which, however, the excrescences were collapsed and indistinct owing to the less perfect state of preservation. On the palate (text-fig. 62, A) the mucous membrane is raised into two fringed ridges divergent towards the pharynx; the upper part of the pharynx is occupied by a pair of large, elliptic, soft, cushion-like pads, into which the pharyngeal denticles are sunk, and in front of each of which two long papillæ are suspended from the roof of the pharynx. Below (text-fig. 62, B), in the median line between the roots of the anterior branchial arches, a high, short ridge rises, with a fringed flap dependent on each side; finally each branchial arch is provided with two rows of soft papilliform gill-rakers.

There are two functions which may be ascribed to this singular structure. It may serve as an organ of taste by which the fish is able to distinguish in muddy water between nutritive and uneatable substances: or, as many Cat-fishes carry their ova and young in the mouth, it may assist in the lodgment or, perhaps,

[1] Unfortunately I am unable to re-examine the type of *E. mandibularis*. The majority of the specimens described in the paper quoted were lent to me for description by my friend, the late Mr. T. Moore, Curator of the Free Public Museum, Liverpool, with the understanding that all unique types should be returned to him. This was done, and the safe arrival of the specimens acknowledged by him. However, none of them can now be found by Mr. Moore's successor, Dr. J. O. Forbes, who, at my request, kindly instituted a search for them.

in the nutrition of the fry. In a female 377 millim. long the structure is but little developed.

Text-fig. 62.



Mouth of *Chrysichthys lagoensis.*
A, palatal view; B, lower view.

AMPHILIUS PLATYCHIR Gthr.

This species varies somewhat in the relative proportions of the dorsal fins. In well-nourished and well-preserved examples the adipose fin rises along a greater extent of the dorsal profile, thus approaching nearer to the rayed fin: a condition not rarely observed in other Siluroids with a long adipose fin. The barbels are distinctly compressed. The back of these Gold Coast specimens is marbled; dorsal and caudal fins with a black band across the base and another across the middle.

The specimens were collected on the River Atesu, and are probably young, being 2½ inches long. The occurrence of these specimens at no great distance from the mouth of the river proves that *Amphilius* is not confined to mountain-streams[1].

NOTOGLANIDIUM, g. n.

Head broad, depressed, covered with thick skin; eyes small, without free orbital margin, situated at the upper side of the head; posterior nostrils in a pit rather nearer to the eye than to the end of the snout, anterior in the upper lip, terminating in a short tube pointing downwards. Snout broad, with rather wide mouth and three pairs of barbels. Teeth minutely villiform, none on the palate. Gill-membranes attached to the isthmus without

[1] The typical specimens are stated to be from Sierra Leone, and there is no reason to doubt the correctness of the statement (see Boulenger, Ann. & Mag. N. H. 1898, i. p. 254). They were given to me on the occasion of a visit to Fort Pitt Museum in 1862 by one of the Army surgeons, who had brought them from Sierra Leone where he had been stationed.

a free central portion. Anterior dorsal rather long, with more than seven rays and with a pungent spine; adipose fin low and long; ventrals six-rayed, below the posterior third of the dorsal.

NOTOGLANIDIUM WALKERI, sp. n. (Plate XXXII.)

D. 1/14–15. A. 12. P. 1/7. V. 6.

Body moderately elongate, of nearly the same depth in its whole length, the tail being strongly compressed. Head depressed, much broader than deep, two-sevenths of the total length (without caudal); the very small eye entirely in the anterior half of the head; snout broad, depressed, two fifths of the length of the head, nearly twice as long as the interorbital space is long. Mouth anterior, with the upper jaw rather larger, surrounded by fleshy lips; all the barbels are rather thick near their base: the maxillary extending to the middle of the operculum, the outer mandibulary to the base of the pectoral fin; the inner mandibulary rather shorter than the maxillary. The maxillary patch of teeth is single, oblong, small, but wider than long; the mandibulary patches separated in the middle, smaller than, but similar in outline to, the maxillary.

Pectoral fins short, not longer than ventral, with a strong spine, which, however, is enveloped in thick skin, only its point being free. Dorsal fin very low, only about half as high as the body, with a singularly short spine, not quite half as long as the snout. Adipose fin long, low, commencing shortly behind the dorsal and subcontinuous with the caudal. Caudal rounded.

Reddish-brown, darker on the back, body, dorsal and caudal fins, with scattered round black spots, the spots on the caudal fin being the more numerous and smaller.

Total length 122 millim.

Two specimens from the River Ibbi (Apollonia).

SYNODONTIS ROBBIANUS J. A. Smith.

Several young specimens (3–6 in. long) from the R. Offim.

On comparing these specimens with the single young specimen of *S. robbianus*, I find that they have the interorbital space a little broader than the Old Calabar fish. This does not seem to me to constitute a distinctive specific character.

MALAPTERURUS ELECTRICUS L.

A young specimen from the R. Offim.

BARBUS CAMPTACANTHUS Bleek.

Many specimens were collected at Infoan, at the town of Akropon, and on the River Atesu.

BARBUS TRISPILUS Bleek.

Many specimens from Infoan, Akropon, and Ingogosu, a village in the mining centre of Kinkiankwâ.

LABEO WALKERI sp. n. (Plate XXXIII.)

Closely allied to *L. brachypoma*.

D. 14. A. 7. L. lat. 33. L. transv. 4/6.

Mouth broad. Lips very thick, with a distinct inner fold in their entire circumference; lower lip fringed along its anterior and posterior margins. Snout thick, produced, much projecting beyond the lower jaw, with a broad lobe on each side; the terminal portion of the snout is rather contracted and turned upwards; maxillary barbel small, hidden in the lateral groove. Eye lateral, immediately below the upper profile, about as large as the exposed portion of a scale, situated entirely in the posterior half of the head. Head small and thick, a little less than one fourth of the total length (without caudal); the width of the flat interorbital space one half of the length of the head. Gill-cover very short. There are three longitudinal series of scales between the lateral line (which is indistinct) and the ventral fin. The free portion of the scales much higher than long. Dorsal fin high, with the upper margin straight, equidistant from the root of the caudal and the front margin of the orbit; anal extending to the root of the caudal, at least in our largest example; caudal forked. Pectoral fin not reaching the base of the ventral; ventral inserted in front of the vertical from the last dorsal ray. Body moderately elongate, tail strongly compressed; the height of the body is not quite one fourth of the total length (without caudal); free portion of the tail as deep as long, its greatest depth being two thirds of the length of the head. Coloration uniform.

Snout covered with tubercles in mature specimens.

Several specimens from Nyankoma, the largest measuring 205 millim.

HAPLOCHILUS SPILAUCHEN Dum.

Town of Akropon, and Infoan (a village on a tributary of the Offim R.).

HAPLOCHILUS INFRA-FASCIATUS Gthr.

Bokitsa Mine (Wasa district); R. Atesu.

ALESTES LONGIPINNIS Gthr.

Alestes chaperi Sauvage, Bull. Soc. Zool. France, vii. 1882, p. 320, pl. v. fig. 3.

From the examination of a long series of specimens, including types of *A. longipinnis* and *A. chaperi*, I come to the conclusion that the two forms should not be specifically separated. *A. longipinnis* was described as having the origin of the dorsal fin nearer to the end of the snout than to the root of the caudal, *A. chaperi* being distinguished by a more backward position of that fin. However, in some of the specimens before me the first dorsal ray is exactly midway between those two points; and I am unable to find any other specific differences.

ALESTES MACROLEPIDOTUS C. V.

R. Offim and R. Enon, village of Nyankoma.

PETERSIUS OCCIDENTALIS Gthr.

Many specimens from Akropon and Infoan.

HYDROCYON LINEATUS Schleg.

R. Offim and R. Enon, Nyankoma.

SARCODACES ODOE Bl.

R. Enon, Nyankoma.

NANNOCHARAX FASCIATUS Gthr.

Town of Akropon.

MORMYRUS USSHERI Gthr.

R. Offim.

EXPLANATION OF THE PLATES.

PLATE XXX.

Chromis busumanus, p. 333.

PLATE XXXI.

Chromis multifasciatus, p. 333.

PLATE XXXII.

Notoglanidium walkeri, p. 337.

PLATE XXXIII.

Labeo walkeri, p. 338.

4. On a Specimen of the Okapi lately received at Brussels. By C. I. FORSYTH MAJOR, F.Z.S.

[Received November 18, 1902.]

(With Text-figures 63–67.)

Last month the Authorities of the Congo Independent State received the skin of an Okapi which was at first supposed to have been obtained by a missionary stationed at or near Stanley Pool, but which subsequently proved to have been forwarded by the Commandant Sillye, "chef de la zône du Haut-Ituri." Though it was apparently of an adult individual, the skin shows no traces of horns.

The examination and comparison of the two Brussels skins, of which photographs are exhibited, show first of all that in the pattern of the striping, especially of the hind-quarters, some variation occurs between one side and the other; this warns us not to attach too much importance to similar variations when

occurring in different specimens. Also, when pointing out the differences in this respect between the horned Tervueren and the London specimen[1], I have taken care to state in a general manner that the latter differs from the former in the predominance of the white over the black in the fore legs, and in the converse condition in the hind legs. The general coloration of the Tervueren skins is dark brown, as opposed to the rich red-brown colour of the specimen in the Natural History Museum, which shows a darker dorsal stripe; the dorsal stripe in the former being lighter than the general coloration. The lateral parts of the face, which are creamy white in the London specimen, are greyish in the mounted individual of Tervueren. In all these features excepting the dorsal stripe, which I have omitted to verify, the newly-arrived skin agrees with the Tervueren specimen.

The last mail, which arrived at Antwerp the 4th of this month, brought the skeleton of the specimen to which belongs the skin received a few weeks before.

The animals are apparently skinned by the natives on the spot where they are killed, which may be situated at a considerable distance from the nearest post; their invariable custom in skinning the animal seems to be to cut away the generative organs, so that the Belgian officials have to rely on the information of the natives as to the sex of an individual. In the case of the London specimen and the one arrived the other day, there was no information whatever in this respect. The first skin received at Brussels was stated to be that of a female, and, as I had at the time no reason to doubt this statement, I described[2] the adult female of the Okapi as being provided with horns like the male.

The skull recently received is that of a quite adult individual; the teeth are well worn and the coronal suture is obliterated. The two bumps rising from the posterior region of the frontals show about the same degree of development as in the larger of the two skulls in the Natural History Museum, but the diffuse swelling of the surrounding region, produced by a greater development of the underlying air-sinuses, makes them appear less prominent.

There are no traces whatever of horns. Apart from this, the skull exhibits the same characters which I have pointed out as being of specific value in the horned skull; it is narrower still than the latter, the absence of horns sufficiently accounting for this difference; the maximum of width is situated behind the orbits, therefore further back than in the London skull; the parietal region and the zygoma are shorter; and the maxillary region above the cheek-teeth lower, both absolutely and relatively. The last character appears to acquire more weight from the circumstance that the London skull is not adult, because the vertical

[1] 'La Belgique Coloniale,' Nov. 9th, 1902, p. 532.
[2] 'La Belgique Coloniale,' May 25th, 1902, p. 245; P. Z. S. 1902, ii. p. 77.

diameter of the maxillary increases with age in the Ungulates generally and in the Giraffe in particular.

Another feature which seems to be of specific value and which is rather striking, is the difference in the shape of the orbits. Professor Lankester has described the orbits of the London specimen as rectangular, whereas in the two specimens of the Tervueren Museum they are circular as in the Giraffe. I was at first inclined to ascribe this disagreement to a difference of age; but on closer inspection I do not see how by further growth this change of form could be brought about. In the Ruminants generally it is precisely in the young that the orbit is more regularly circular.

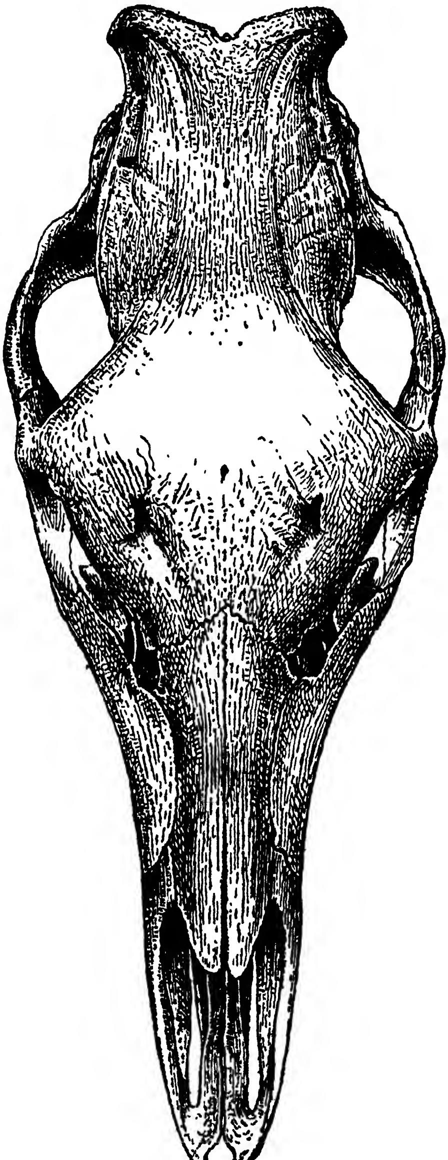
Considering the agreement of the two skulls and the two skins, I have not hesitated to ascribe the specimen lately arrived to the same species as the skeleton of the one and the skin of the other of the two individuals formerly received by the Tervueren Museum.

The absence of horns in this adult specimen is, in my opinion, a sexual character; the hornless skull being besides slenderer, as is the case generally in female Ruminants. This conclusion as to the sex was arrived at before the pelvis belonging to the same skeleton as the hornless skull had been examined; the pelvis having been sent to London, I have been able to compare it with the one belonging to the horned skull. There cannot remain the slightest doubt that the former is that of a female, the latter that of a male individual.

It follows that not only the skeleton, of which the horned skull forms part, is that of a male—and about this I have never had any doubt—but also that the mounted skin of the Tervueren Museum, which also exhibits horns, is of the male sex. The difference in size and the slight differences in shape of the two pairs of horns are due to the skin being that of a younger specimen, as is evident from the non-fusion of its ossicusps with the frontal.

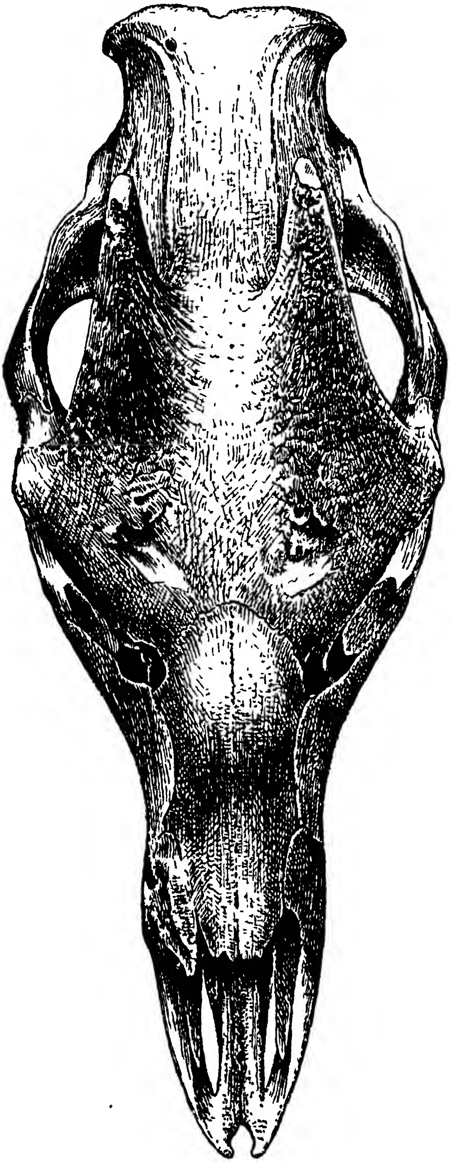
At present the exact locality of the specimen last arrived is unknown. According to information received by the Congo State authorities, it results that the Okapi is not restricted to the region inhabited by the Wambutti dwarfs. Five years ago, in 1897, an agent of the Congo State forwarded to his superiors the description of a beast which he believed to be an antelope and which is called *Ndumbe* by the Momvus, a tribe bordering to the south of the Mangbattu country (lat. 3° N., long. 28° E.), whence the skins exhibited to a former meeting by Mr. Boulenger were obtained. The description of the "*Antilope ndumbe*" is clearly that of an Okapi :—"De taille supérieure au buffle, tête noire, le cou et le corps brun marron; arrière-train zébré par des raies noires et blanches. Ces raies forment des anneaux sur les quatre membres. La queue est longue de 50 centimètres et terminée par une touffe de poils. Elle a les formes gracieuses et arrondies du zèbre. Sa chair est excellente."

Text-fig. 63.



Upper view of skull of *Okapia liebrechtsi*, adult ♀. ⅓ nat. size.
Congo State Museum at Tervueren, near Brussels.

Text-fig. 64.



Upper view of skull of *Okapia liebrechtsi*, adult ♂. ⅓ nat. size.

(From the same specimen as that figured in side view above, p. 73 (text-fig. 7). Congo State Museum at Tervueren.)

Lieutenant Leoni, who forwarded to Brussels the first specimens, also writes that the Okapi is called *N'dumbe* by the Momvus, between the rivers Nepoko and Adjamu, and on the Rubi, and that he himself had met with two herds on the Nepoko. He mentions besides two other names of the Okapi: in the country of the Mokumus it is called *M'Boote*, and in the Kiuvuailia country *Kenghe*. I have not been able to find these two districts marked on the maps.

There are already quite as many native denominations known as there are binomial names for the Okapi, but it does not follow that each tribe enjoys the possession of a distinct form. To return for a moment to the question of different species: from what I have said, it may be seen that the new material rather confirms my view as to the specific distinctness of the Brussels specimens, although speaking generally I am *à priori* more in sympathy with uniting than with dividing species, and have come to consider new specific names as being in many cases an evil, although a necessary one.

Personally I esteem it a more fascinating and a more important task to investigate the relations of the Okapi with the Giraffe on the one hand, and its fossil relatives on the other. This investigation culminates in the question, to which I have already endeavoured to give an answer [1], whether the main characters in which the Okapi differs from the Giraffe are generalized characters, or whether it is the reduced, degenerate survivor of a series, "the most modern and most modest member of a tribe which has flourished in bygone times," as it has been put [2]. I hope to show that a similar inquiry is not "a fruitless amusement."

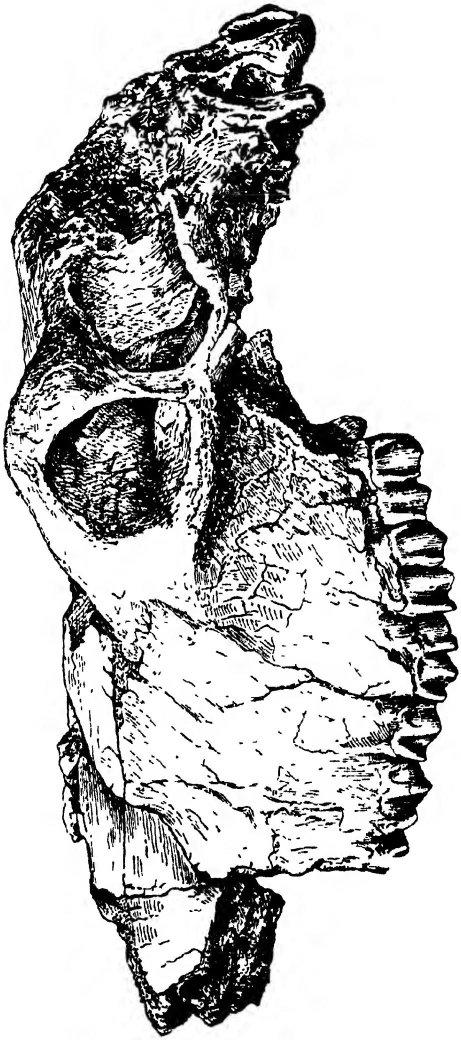
The importance of the discovery of the Okapi from a scientific point of view consists, of course, in the quite unhoped-for addition of a second living genus to a family of Ruminants which was hitherto represented in the recent fauna by the isolated and aberrant type of the Giraffe alone.

One important point upon which the Brussels material has thrown light is the mode of development of the horns. The horn-cones which had remained attached to the first skin received in Brussels having been macerated, it became clear that, as in the Giraffe, the horns of the Okapi are composed of two parts: (1) of the tuberosities or bumps of the cranial bones—the frontal alone in the case of the Okapi—which increase with age; and (2) of the sort of epiphysis, termed *ossicusp* by Prof. Lankester, which in the younger animal is separated from the underlying frontal by a stratum of fibrous structure, but finally co-ossifies with the frontal, without any trace of a suture remaining in the old animal.

Apart from the circumstance that in the Giraffe this "ossicusp" is placed on two bones, the parietal and the frontal, we have this other difference, that the tips of the horns present a polished

[1] 'La Belgique Coloniale,' May 25th, 1902, p. 245; P. Z. S. 1902, ii. p. 79.
[2] P. Z. S. 1892, ii. p. 214.

Text-fig. 65.



Side view of incomplete skull of *Samotherium boissieri*, adult ♀. ¼ nat. size.

Original, from Upper Miocene of Samos, in the Brit. Mus.

appearance in the Okapi, suggesting that they had not been covered by skin. This would imply that very probably the tips of the horns are shed. As this question will doubtless very soon be resolved by the arrival of new material, I find it safer to leave it open for the present, the polishing being possibly due to some other cause.

I have classed the characters of the Okapi, cranial and others, first of all into four categories, according to their agreement with or disagreement from, the nearest related fossil forms, *Palæotragus* (= *Samotherium*) on the one hand, and the Giraffe on the other; a fifth category gives the characters according to which it holds an intermediate position.

I. *The characters which the Okapi shares with Palæotragus*, besides those which both have in common with the Giraffe, are the following:—

1 & 2. Proportionate length of the limbs and of the neck. I have formerly stated [1] that in this respect the Okapi closely agrees with the fossils.

3. One pair of horns only, situated on the frontal bones alone, and presumably present only in the male sex (see text-figs. 63-66).

4. Elongated and horizontal parietal region.

5. Lower contour of mandible convex (almost horizontal in the Giraffe), anterior portion of mandible turned upwards and more massive than in the latter; for characters 5 and 6 compare the text-figs. 6 (*Samotherium*) and 7 (*Okapia*) on p. 73 of my former paper with text-figs. 11 and 12 (*Giraffa*) on p. 76.

6. Lower contour of præmaxillaries and of adjoining anterior portion of maxilla horizontal (bent downwards in the adult Giraffe).

II. *Characters in which the Okapi differs from Palæotragus.*

1. Smaller size of incisors and canine, a feature pointed out already by Prof. Lankester.

2. Cheek-teeth more brachyodont, at any rate more so than in the larger fossil form, *Samotherium boissieri.*

3. Air-sinuses of the cranial bones much more developed, extending even to the *basis cranii.*

4. Narrow frontal region, orbits not telescopic (compare text-figs. 63 and 64 with text-figs. 65 and 66).

5. Orbits situated more forward in relation to the cheek-teeth series.

6. Horns placed farther backward and comparatively smaller.

7. Mandibular angulus more produced backward.

8. Five tarsal bones—cuboid; scaphoid; cuneiforms 1, 2, & 3—are fused into one bone (in *Palæotragus* into three, as in the great majority of Ruminants).

[1] 'La Belgique Coloniale,' May 25th, 1902, p. 245; P. Z. S. 1902, ii. p. 78.

III. *Characters which the Okapi has in common with the Giraffe.* Those characters mentioned in paragraph I. which are equally shared by all three animals, together with the following:—

1. Horns covered by the skin; their mode of growth in the main identical.
2. Extensive air sinuses of the cranial bones.
3. Shape of the mandibular angulus of the Okapi approaching the Giraffe, though somewhat intermediate between the form in the latter and that of *Palæotragus*.
4. Fusion of the five tarsal bones mentioned—this takes place in the two known skeletons of the Okapi; it is not the *general* rule in the Giraffe.

IV. *Characters in which the Okapi differs from the Giraffe.*

1. Smaller size.
2. The differential characters of the skins.
3. All those features which, apart from the family characters, the Okapi has in common with *Palæotragus*.
4. Cranial air-sinuses less developed in the Okapi, with the exception of those in the bony palate, which are conversely *much more* developed in the Okapi than in the Giraffe.
5. Narrow frontal region; orbits not telescopic (compare text-figs. 63 and 64 with text-fig. 67).
6. More anterior position of the orbits.
7. Tympanic bullæ and ears larger.
8. Apparent later development of the horns, which remain smaller.

V. The Okapi holds an *intermediate* position between *Palæotragus* and the Giraffe in the following characters:—

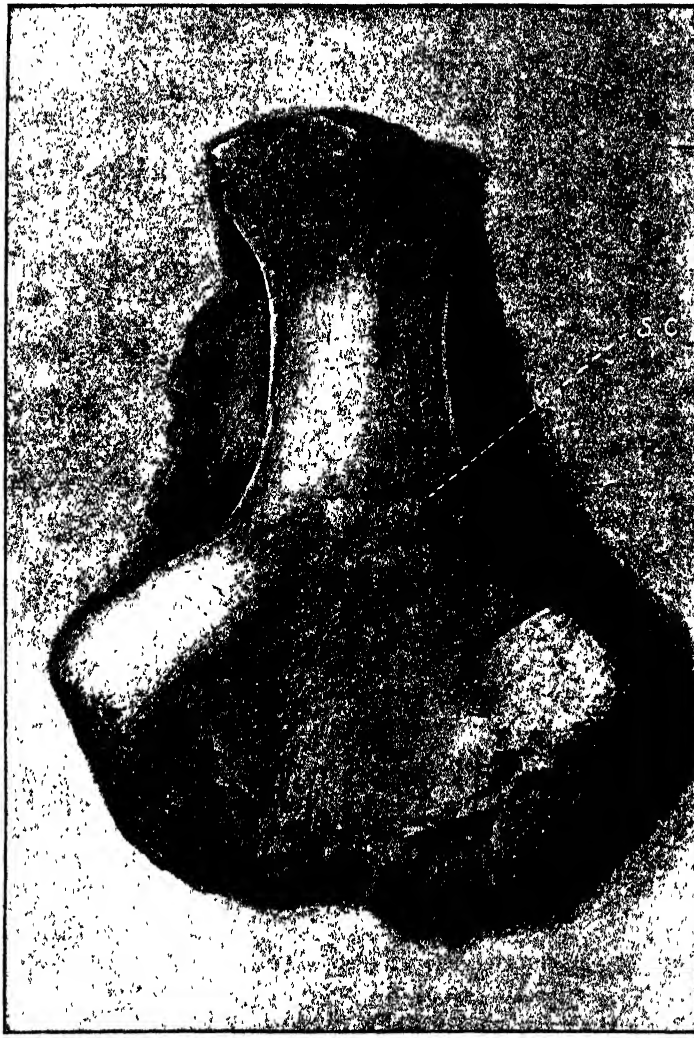
1. Degree of development of the air-sinuses in the cranial roof-bones.
2. Position occupied by the paired horns (compare text-fig. 7 (p. 73) with text-fig. 6 (same page) and text-figs. 11 and 12 (p. 76).
3. Conformation of the mandibular angulus, which is more produced backward than in *Palæotragus*, but less so than in the Giraffe. See the side views of the crania on pp. 73 and 76.

VI. A very few features are *common to the Giraffe and to Palæotragus*, to the exclusion of the Okapi.

1. Large incisors and canine.
2. Backward situation of the orbits in relation to the tooth-series.
3. Broad frontal region; orbits telescopic.

Almost all the characters in which the Okapi differs from the Giraffe are more primitive features. The exceptions are the large air-sinuses in the bony palate of the Okapi, and presumably also the large size of the ears. As pointed out, the Okapi shares a great part of these primitive features with the fossil Giraffidæ

Text-fig. 66.

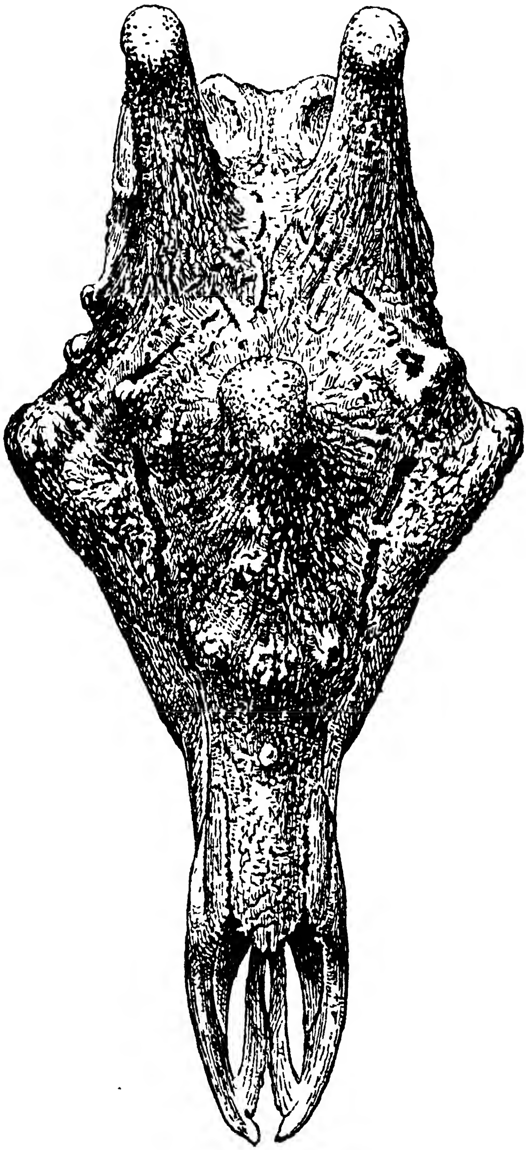


Upper view of the posterior portion of the skull of *Samotherium boissieri*, adult ♀. $\frac{1}{3}$ nat. size.

Upper Miocene of Samos. Same specimen as that figured in side view above, p. 74 (text-fig. 9). Barbey Collection, Valleyres (Switzerland), No. 15.

s.c. = coronal suture.

Text-fig. 67.



Upper view of the skull of *Giraffa camelopardalis*, adult ♂. $\frac{1}{8}$ nat. size.
From Guas 'Ngishu Plateau on Mt. Elgon, Brit. E. Afr.—B. M.

here considered. There are several, however, by which it appears to be *even more generalized than Palæotragus*; namely, the narrow frontal region with its non-telescopic orbits, the anterior position of the latter, the smaller size of the horns, and the more brachyodont condition of the cheek-teeth (as compared with the large fossil species *Samotherium boissieri*). In one feature only, the large extension of the air-sinuses in the bony palate, the Okapi has conversely progressed further than the Giraffe.

Palæotragus, finally, is more generalized than the Okapi—and, as a matter of course, more so than the Giraffe—in the non-fusion of the five tarsal bones into one, in the comparatively very slight extension of cranial air-sinuses, and in the anterior position of the horns.

To sum up the state of our present knowledge of the Okapi.—In the species preserved at Tervueren (*Okapia liebrechtsi*) the male is provided with horns, but the same will presumably prove to be the case in the species represented in the Natural History Museum also.

The mode of formation of the horns of the Okapi is the same as in the Giraffe. In the present state of our knowledge they are limited to the male alone of the former, so that the Okapi is in this respect on the same level as *Palæotragus*, the Giraffe having progressed farther.

Besides the last-mentioned some further features which the Okapi shares with *Palæotragus*, and all of them of a more generalized character as compared with the Giraffe, have been added to those formerly pointed out.

One feature has been added to those formerly mentioned, in which the Okapi occupies an intermediate position between *Palæotragus* and the Giraffe.

And, lastly, we have been able to adduce some characters in which the Okapi appears to be even more generalized than *Palæotragus*. It is this last category especially which adds weight to the assumption that Africa was the original home of the Giraffidæ.

December 2, 1902.

Dr. Henry Woodward, F.R.S., Vice-President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of November 1902:

The registered additions to the Society's Menagerie during the month of November 1902 were 68 in number. Of these 41 were acquired by presentation and 1 by purchase, 1 was born in the Gardens, 21 were received on deposit and 4 in exchange. The total number of departures during the same period, by death and removals, was 115.

Amongst the additions special attention may be called to a fine

adult female of the Equine Antelope (*Hippotragus equinus*), from Bechuanaland, presented by Major Charles Frederick Minchin, D.S.O. No specimen of this Antelope has been received in the Society's Gardens since 1878, and it is now becoming very scarce in South Africa.

Mr. Sclater called attention to the specimen of the Greater Bird of Paradise (*Paradisea apoda*), now living in the Society's Gardens, which had been received from the Zoological Gardens, Calcutta, on the 15th June, when it was in full dress. It had begun to moult at the end of June, and had shed all its plumes in *three nights*. (The bird was not observed to cast any plumes during the day.) The bird did not commence to cast its flight-feathers till the beginning of August, and it cast about two feathers per week up to the beginning of November. The *new* plumes began to show about the last week in August. The bird had now completed its moult, and was in fine health and condition. It was very tame and lively, and came readily to be fed by hand. It was fed upon boiled rice, boiled potatoes, boiled carrots, boiled eggs, bread, maw-seed, and German paste, also on bananas, grapes, pears, and nuts. It has one *raw* fresh egg per week, a fresh-killed mouse occasionally, and had all the damaged moths in the Insect-house. Of the last-named the bird was particularly fond, as also of small pieces of sweet biscuits.

Mr. F. E. Beddard, F.R.S., exhibited the lower jaw of a Wombat which had died in the Society's Gardens, apparently from peritonitis. The molar teeth on both sides of the jaw had grown inwards so as to confine the tongue below them. Though it was possible to free the tongue by bending it sideways and then pulling it out, it seemed doubtful whether this could have been done by the animal itself during life, or, if so, whether it could have been replaced as it was found after death. The uselessness of the tongue as an aid to mastication must not be assumed from the conditions observable in this specimen, since it is quite conceivable that the organ may have been paralyzed, and thus rendered it possible for the teeth to close in above it. The animal was old, having been acquired in 1885.

Dr. Hans Gadow, F.R.S., gave an account (illustrated by lantern-slides) of his recent expedition to Southern Mexico. He described the Valley of Mexico, and discussed the question of the Axolotls and their metamorphosis. He also gave an account of his ascent of the Volcano of Orizaba—on which he camped for several weeks at various high altitudes,—and of the two types of *tierra caliente* met with on the Atlantic and Pacific slopes, and pointed out the various phases of animal life seen by him in these different districts.

The following papers were read:—

1. On the Variation of the Elk (*Alces alces*). By Dr. Einar Lönnberg, C.M.Z.S.

[Received November 4, 1902.]

(With Text-figures 68–76.)

In Sweden it is not uncommon to hear professional elk-hunters talk of "two kinds of Elk," distinguished as follows:—The one is dark blackish-brown in colour, short-legged, and provided with broadly palmated antlers. It is also said to be less shy and more apt to "make a stand" against dogs when hunted than the other, and, as a rule, is fatter and more fleshy. The second is said to be a longer-legged and more slenderly built animal, of a lighter colour, more especially on the legs, which are described as almost whitish. It is usually more shy, and thus more difficult to approach with dogs when hunted. The antlers are deeply cleft, with little or no palmation, and end in long rounded tines. In some districts hunters distinguish these two forms by distinct names, as, for instance, "grass-elk" and "mountain-elk," and report that they frequent different localities; but the statements on this point are rather vague and contradictory, and it is questionable to how much reliance they are entitled.

To some extent, at any rate, the above-mentioned variations may be due to difference of age—an old bull, for instance, being more apt to resist dogs than a younger animal. The difference in colour might also be attributed to the same cause; and the statements about longer or shorter legs are of no value unless supported by exact measurements, a fat and bulky individual appearing shorter-legged than a more slender animal with limbs of the same length. Sportsmen, on the other hand, who concentrate their interest on the trophies they carry home, devote special attention to the antlers; and it has accordingly become a custom among them to speak about "cervine" as opposed to "palmate" antlers in Elk. Antlers of both types, as well as intermediate forms, have been shown at several exhibitions, and may also be seen in private collections in Sweden. In the Baltic Provinces especially, sportsmen have noticed the variation of Elk, and in the 'Baltische Waldmannsblätter' for 1901 the question has been raised whether there are one or two kinds ("races" or "species") of Elk in these countries; some writers maintaining that there are certainly two forms—the one with broad shovels (palmations) to the antlers, the other without palmation to these appendages, which terminate in long simple tines. The Elk with palmated antlers is said to be somewhat earlier in rutting and cleaning and shedding its antlers than the other. Some sportsmen believe that the non-palmated Elk has immigrated from the north-east into Estland and Livonia; others, however, deny the immigration theory, and consider the

non-palmated Elks to be degenerate stags. The latter theory accounts both for the difference in external appearance and for the difference in the breeding-time, &c.; an elk in its prime being always earlier than a degenerate animal in rutting and shedding. From the department of Grodnö, Elk with and without palmation, as well as intermediate forms, have also been reported. Some elk-antlers from the Ural are said to be fully palmated, while others are of the intermediate type.

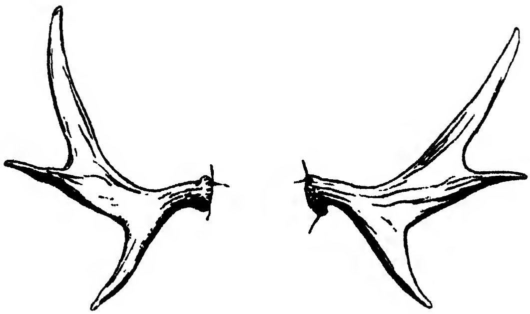
The interest in regard to the variation of the Elk has, however, been intensified during the present year, owing to the circumstance that Mr. Lydekker (Proc. Zool. Soc. 1902, vol. i. p. 107) has named a new species (*Alces bedfordiæ*) from Siberia, the chief characteristic of which is the non-palmated antlers. Knowing how much the Swedish Elk varies in regard to its antlers, it has seemed to me that the type of antler displayed by *Alces bedfordiæ* falls within the range of variation of the common Elk, and I have therefore contributed the following notes to the Society. They are based on the study of a large number of elk-antlers from different parts of Sweden, and I have this autumn specially studied no less than 32 elk-heads sent to Mr. G. Kolthoff's establishment in Upsala to be mounted. From these I have selected nine, figures of which are here photographically reproduced on the same scale. Three of these pairs belong to the true "palmate" type, three to the "cervine" type, and two to the intermediate, while one is anomalous. The "palmate" and "cervine" antlers have been so selected as to form two series, each of the three specimens representing different ages. The two "intermediate" specimens belong to adult animals which ought to have their characteristics fully developed. All the heads belonged to Elk shot this autumn in the eastern part of Central Sweden within the following limits, namely, from the central district of Gestrikland in the north, to northern Östergötland in the south and to Nevike in the west [1]; all being thus within a small area for such a widely distributed animal as the Elk. Climatic and other physical conditions do not vary much within the area in question; and the variation in the different specimens is therefore all the more striking.

The palmated series is represented by text-figs. 68–70. Text-fig. 68 shows the youngest pair, which has not developed more than three tines to each antler, but displays, nevertheless, a rather broad palmation for such an early stage. This pair is from Upland. Text-fig. 69 represents a somewhat older pair from Finspång in Northern Östergötland. The posterior or upper palmation is well developed, with four points on the right and five on the left. The anterior branch displays two points and an incipient palmation on the right side, but only a strong tine on the left. Text-fig. 70 (p. 355) shows the antlers of a still older and better developed stag, with large posterior as well as anterior palmations. The latter have

[1] These limits may also be expressed in the following way:—Northern limit 60° 40′ N.; Southern 59° 30′ N.; Western about 15° E. (Greenwich).

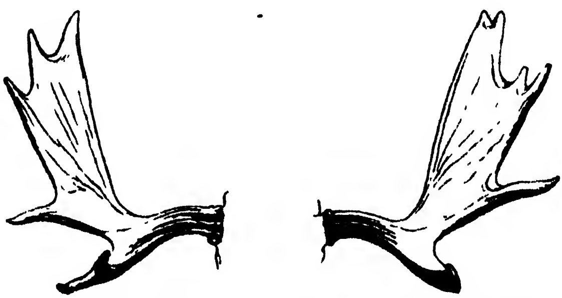
four points on either side, the former four points on the right and five on the left side. This Elk was shot near Sandriken's iron-works in Gestrikland.

Text-fig. 68.



Antlers, of the palmated type, of young Elk from Upland.

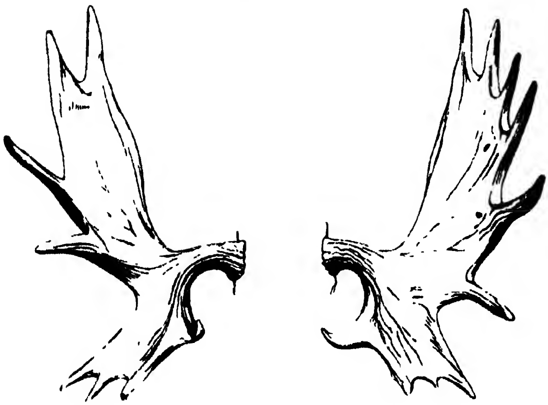
Text-fig. 69.



Antlers of a somewhat older Elk than that shown in text-fig. 68, from Finspång, Östergötland.

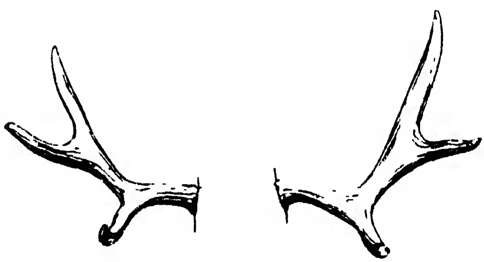
The non-palmated or "cervine" series is represented by text-figs. 71–73. Text-fig. 71 shows three symmetrical points, viz., an upper or posterior fork, and an anterior simple tine, on each side, but no palmation; it may be compared with text-fig. 68 as being probably of the same age. It is taken from an Elk shot in the central part of Östergötland. Text-fig. 72 displays four points on each side, viz., an upper and an anterior fork; it is from Gimo in Eastern Upland. Text-fig. 73 (p. 356) shows the "cervine" type of antlers of an old stag shot at Krusenberg in Upland, not far from Upsala. The upper or posterior portion of the left antler has three, and that of the right four large points. The anterior portion of both antlers is formed by a greatly developed fork, the long median branches of which are, however, not fully shown in consequence of their inclination towards the camera. The intermediate forms represented by text-figs. 74 & 75 speak for themselves. Text-fig. 74 might

Text-fig. 70.



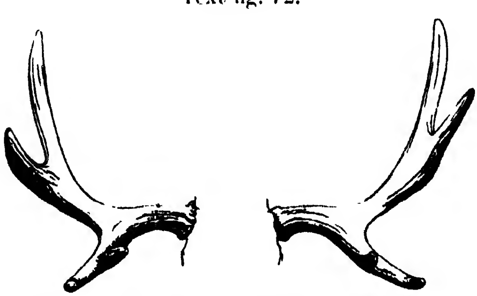
Fully-developed antlers, of the palmated type, of adult Elk from Gestrikland.

Text-fig. 71.



Antlers, of the "cervine" type, of young Elk from Östergötland.

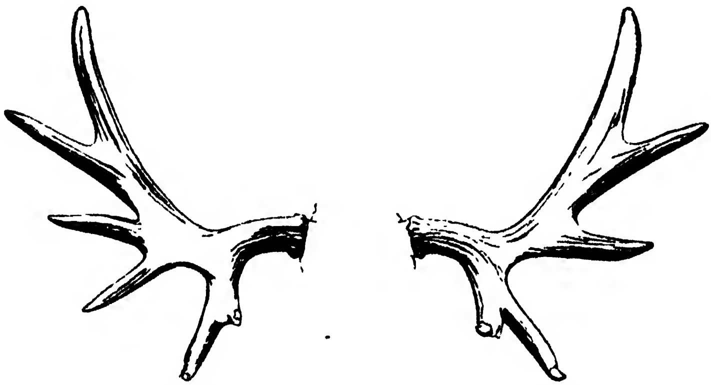
Text-fig. 72.



Antlers of a somewhat older Elk than that shown in text-fig. 71, from Gimo, Upland.

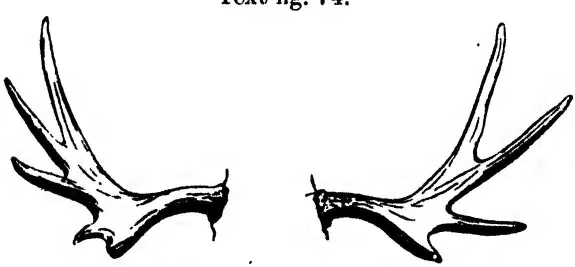
perhaps be termed palmated, but the points are very long and the palmations narrow; it is from the neighbourhood of Katrineholm in Södermanland. Text-fig. 75 (p. 357) displays on the right antler a narrow posterior palmation, with three long points, and a still narrower anterior palmation with two points. The left antler has the same number of points, but is rather more "cervine" in

Text-fig. 73.



Antlers, of "cervine" type, of adult Elk from Krusenberg, Upland.

Text-fig. 74.



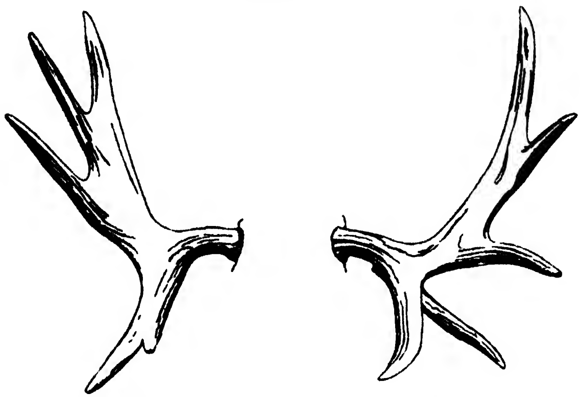
Antlers, of intermediate type, of young Elk from Katrineholm, Södermanland.

appearance. This specimen is from Vretstorp in Nerike. Text-fig. 76 (p. 357) is still more interesting, because while the right antler is palmated, although not much so, and carries rather long tines—three on the posterior palmation and one anteriorly,—the left antler is perfectly "cervine," with three long rounded tines and no palmation. This Elk was shot in Vestmanland at Fellingsbro. Another pair that I have seen does not properly belong to any of these types, since the left antler is anomalous, and shows a tendency to what Nitsche[1] calls "Stangentheilung." It affords, however, a further proof of the great variability of elk-antlers.

[1] Studien über Hirsche, Hft. i. (Leipzig, 1898).

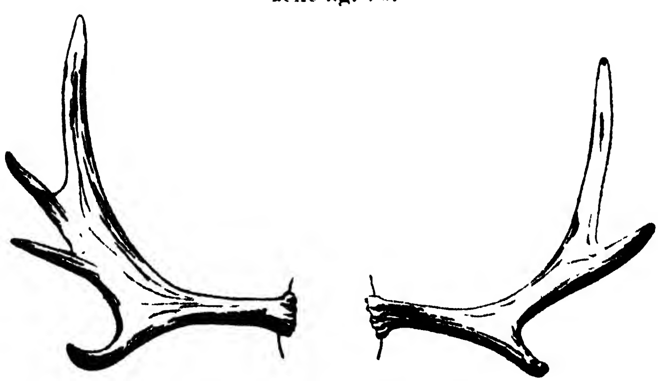
The variability of the antlers is not fully elucidated by these nine specimens; and a number of other variations might be shown, scarcely any two Elk having antlers of precisely the same shape. It must, however, suffice to mention only a few more. An Elk from Karlsboga shows broad palmations, with seven

Text-fig. 75.



Antlers of somewhat older Elk than that shown in text-fig. 74, from Vretstorp, Nerike.

Text-fig. 76.



Antlers of Elk from Vestmanland, Fellingsbro, showing palmated type in right and cervine type in left antler.

almost equal and undivided tines in the posterior and anterior portions. In another Elk, from Kolsva in Vestmanland, on the contrary, the antlers are divided into an anterior and a posterior palmation; both of the same breadth, 14–15 cm., and with three points each. Occasionally, although not often, it happens that

the anterior palmation is larger than the posterior. Sometimes, again, the anterior portion of the antler is bent so as to form more or less nearly a right angle with the posterior palmation; and occasionally the two points of a fork do not lie in the same frontal plane, but one behind the other.

These instances must suffice to show the great variability in the form of elk-antlers, and at the same time to indicate that in Sweden no division into subspecies or races can be founded on such differences, at any rate for the present. It is true that sometimes in a particular district most of the Elk display antlers of the same type; but this is easily explained by the close relationship of the individuals, so that only family groups are formed, and no greater differentiation is indicated.

In order to show the dimensions of the antlers, and to indicate that these also vary greatly, the following table has been drawn up, the heads measured being enumerated in the same order as described above:—

	Frontal breadth between the burr of the antlers.	Circumference of the antlers just above the burr.	Distance between the uppermost tines.	Greatest width between the two most distant points.
	mm.	mm.	mm.	mm.
No. 1	194	152	920	995
2	209	180	870	1105
3	182	182	850	1040
4	187	145	890	1020
5	179	175	905	965
6	205	215	1135	1330
7	194	156	975	1100
8	177	165	860	1035
9	80+40[1]	180	870	1105
10	165	175[2]	905	965

From these measurements it will be seen that the dimensions of skull and antlers are subject to a comparatively great variation, and that, for instance, a smaller frontal width may be united with large antlers, and *vice versâ*. It is also apparent that the antlers of the "cervine" or "intermediate" types reach dimensions approximately equal to, and sometimes indeed superseding, those of the "palmated" type. The "cervine" and "intermediate" types cannot therefore be said to be the result of degeneration in the strict meaning of that word. By this I do not intend to imply that there are no degenerate elk-antlers to be found in Sweden, since such small and degenerate antlers frequently occur. These, however, include "palmated," "intermediate," and "non-palmated" types, although the latter may be the more numerous.

From the more southern provinces especially (such as Småland),

[1] A teratological continuation from the burr of the right side covers a good deal of the frontal. The distance from the left burr to the median line is about 80 mm.; if normal the breadth should thus have been 160 mm.

[2] On the normal side.

I have seen many antlers which might be termed degenerate. The cause of this degeneration may in some cases be insufficient food and poor pasture, but oftener still in-breeding and excessive hunting, or inadequate game-laws. Frequently all the adult stags are shot, so that young males are allowed to breed, which naturally results in weak offspring. In some places it is permitted to kill hinds during the shooting-season, although unlawful to harm the fawns, despite the fact that a fawn of which the mother has been killed will be weak and degenerate. There is thus little wonder that a degenerate stock with small antlers is produced in such districts. This, however, is quite different from claiming all "cervine" and "intermediate" antlers as degenerate. Such a statement is at once disproved by the measurements given above.

The "cervine" and "intermediate" antlers may rightly be termed products of spontaneous variation (not of degeneration), and a glance at many of them reveals the fact that this variation, in a certain sense at least, has gone in a particular direction. The antlers of the Elk are chiefly used as weapons against rivals during the rutting-season. It is therefore apparent that the long sharp tines of the "cervine" and "intermediate" types will be more useful for fighting than the comparatively short points of the extremely palmated type. The bayonet-like and forwardly-directed anterior tines of the former are especially formidable; and it will be evident that the best-armed animal will be victorious, and that when the form of the antlers becomes hereditary in certain localities, Elk with "cervine" antlers must dominate over those with "intermediate" antlers. At the last exhibition in Stockholm (1902) of antlers, from the period 1897-1901, this was proved by a collection of thirteen pairs of heads from eastern Upland, twelve of which were perfectly "cervine," although the thirteenth was broadly palmated. From Vestmanland, again, there was a collection of antlers, chiefly of the "intermediate" type, with narrow palmation and long points. If such family groups live isolated through many generations, it is possible that their characteristics would become constant, but as yet they are not; and since Elk, especially when disturbed, often wander from one tract to another, isolation cannot be effected in districts where they are not yet too scarce[1]. The Swedish Elk with all its variations thus constitutes only one species, although possibilities seem to exist for the origin of different racial types.

Considering the nature of the "cervine" type of elk-antlers, it might in a certain sense be said that it is atavistic, since rounded tines are more primitive than a broad palmation. But, on the other hand, the antlers classed above as "cervine" may be regarded as forming a continuous and direct development of the immature type displayed by the young elk, which in its third year normally carries only a fork on each side. It is also important to note that Elk show a strong tendency to continue

[1] At present Elk are fairly numerous in Sweden, as may be gathered from the fact that last year during the shooting-season more than 2400 were killed.

with their antlers in this forked stage. The antlers, in such cases, only become heavier each year, and show longer tines without developing new points. A similar tendency to remain in the three-pointed stage is also apparent. The forked and three-pointed stages are indeed the starting-points from which the palmated and non-palmated antlers diverge and develop in different directions. The forked stage of the immature antler with rounded tines may to a certain extent be regarded as a repetition of the phylogenetic development, so that in this way the "cervine" elk-antler, whether it be called a development of the young stage or a reversion, displays primitive characteristics in its rounded tines. This must not, however, be understood to mean that I infer that the nearest ancestors of the common Elk had antlers of exactly the same type as those here termed "cervine."

Finally, I will only remark that an Elk with the antlers so well developed as text-fig. 73 (p. 356) is still at its most vigorous age, as a glance at its dentition is sufficient to indicate. The incisors are not so worn but that they form a continuous edge, with the outer broad ends fully in contact with each other. In the same way the molars do not look much worn, the accessory columns of the upper ones being perfectly intact.

2. Note on a Reindeer Skull from Novaia Zemlia. By R. Lydekker.

[Received November 15, 1902.]

(Text-figure 77.)

By the courtesy of Mr. H. J. Pearson, F.Z.S., of Bramcote, Notts, in whose possession is the specimen, I am enabled to bring to the notice of the Society a Reindeer's skull, with a remarkably fine pair of antlers, obtained by that gentleman from the top of a Samoyed's hut in Novaia Zemlia in 1895. The specimen has already been figured, with a brief description, by the owner in his 'Beyond Petsora Eastward' (1899); but its interest is such that I have no hesitation in bringing it more prominently into notice.

The antlers are characterized by the great development and palmation of both the brow- and bez-tines, which are, however (unlike the majority of American Reindeer), not very unequal in size. The beam is of medium length and carries a very large back-tine; above the latter there is a large palmation, most developed on the left side, terminating in a number of irregular snags. The length of the antlers, from base to tip, along the curve is 49 inches; the palmation of the larger of the two brow-tines has a vertical depth of 16 inches, its fellow 11½ inches.

That these antlers are quite unlike those of the Scandinavian Reindeer (or, at least, any that have come under my own observation) is apparent at a glance. They are less unlike those of

the Spitzbergen Reindeer, of which a head is figured in Murray's 'Geographical Distribution of Mammals,' p. 154, fig. 9[1]. In that race the antlers are smaller and lighter, usually with less palmation of the brow-tine, and with the bez-tine simple. The summit of the antler is, moreover, devoid of palmation.

In the Siberian Reindeer (*Rangifer tarandus sibiricus*) as typified by the heads figured in Murray's 'Geographical Distribution of Mammals,' p. 153, the palmation of the brow- and bez-tines is less marked than in the present specimen, and in one case at least these tines are unsymmetrical. The same condition obtains in the antlers of a Reindeer skull in the British Museum from "Siberia" which approximates to the American woodland race.

Turning to American Reindeer, or Caribou, of which a great number of local phases are now recognized, the Novaia Zemlian specimen seems to me to come nearest as regards relative length of antlers to forms like the Alaskan *Rangifer tarandus stonei*[2], intermediate between the true woodland and the true barren-ground type. The present antlers differ, however, markedly from those of the Alaskan race by the much greater palmation of the summit, the much more developed back-tine, and the greater symmetry between the brow- and bez-tines of opposite sides. From *R. t. osborni*[3], of the Cassiar Mountains—another of the intermediate types—they differ by the smaller length of beam, as well as in the greater palmation, although both show a large back-tine. From *R. t. montanus*[4], which more closely resembles the woodland type, as well as from the true woodland, the Newfoundland, and the barren-ground races, the Novaia Zemlian form is markedly distinct, although it is decidedly nearer to the woodland than to the barren-ground type.

On these grounds, coupled with its insular habitat, I feel little hesitation in regarding the Novaia Zemlian Reindeer as forming a distinct local race (American naturalists would probably consider it a species); and I propose to call it *Rangifer tarandus pearsoni*, after the owner of the type specimen here figured. It may be briefly characterized as distinguished from other Old World forms of Reindeer by the symmetry of the antlers and the excessive palmation of both their brow- and bez-tines and their summits. I may add that Baron Nordenskiöld has suggested that the Novaia Zemlia Reindeer reach that island from more northern lands by crossing the ice.

I regret to say that Mr. Pearson is at present unwilling to part with the type specimen; but it may be hoped that he will make arrangements whereby it will eventually come to the National collection.

Mr. Pearson informs me that the animal to which the type skull belonged was killed in the winter of 1894–95, near the hut

[1] The antlers figured by Camerano, Mem. Ac. Torino, vol. li. pl. ii. (1901), are stated by Winge (Meddelelser om Grönland, vol. xxi. p. 457) to come from Greenland.

[2] See J. A. Allen, Bull. Amer. Mus. vol. xiv. p. 145 (1901).

[3] Allen, *op. cit.* vol. xvi. p. 149 (1902).

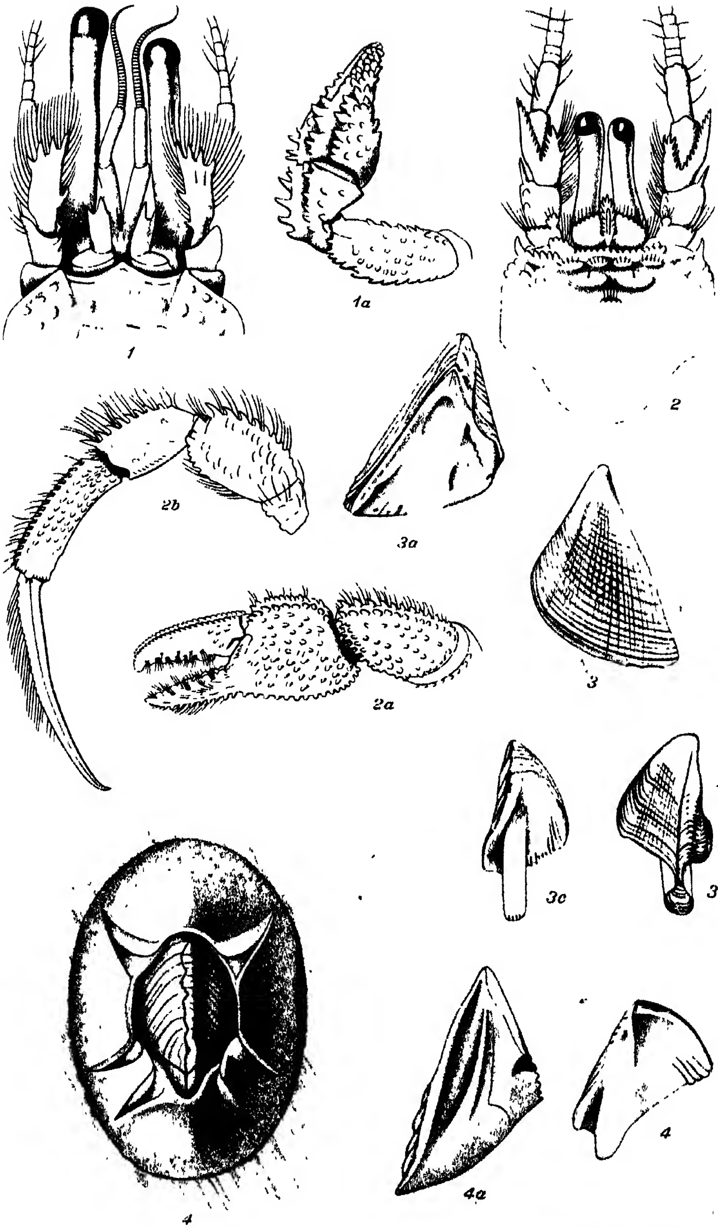
[4] Allen, *loc. cit.*

where he found the latter. He believes that in Novaia Zemlia, where they will probably ere long be exterminated, Reindeer do not lose the velvet from their antlers until about the time navigation closes, so that sportsmen from the south have no opportunity of shooting them in proper condition unless by

Text-fig. 77.

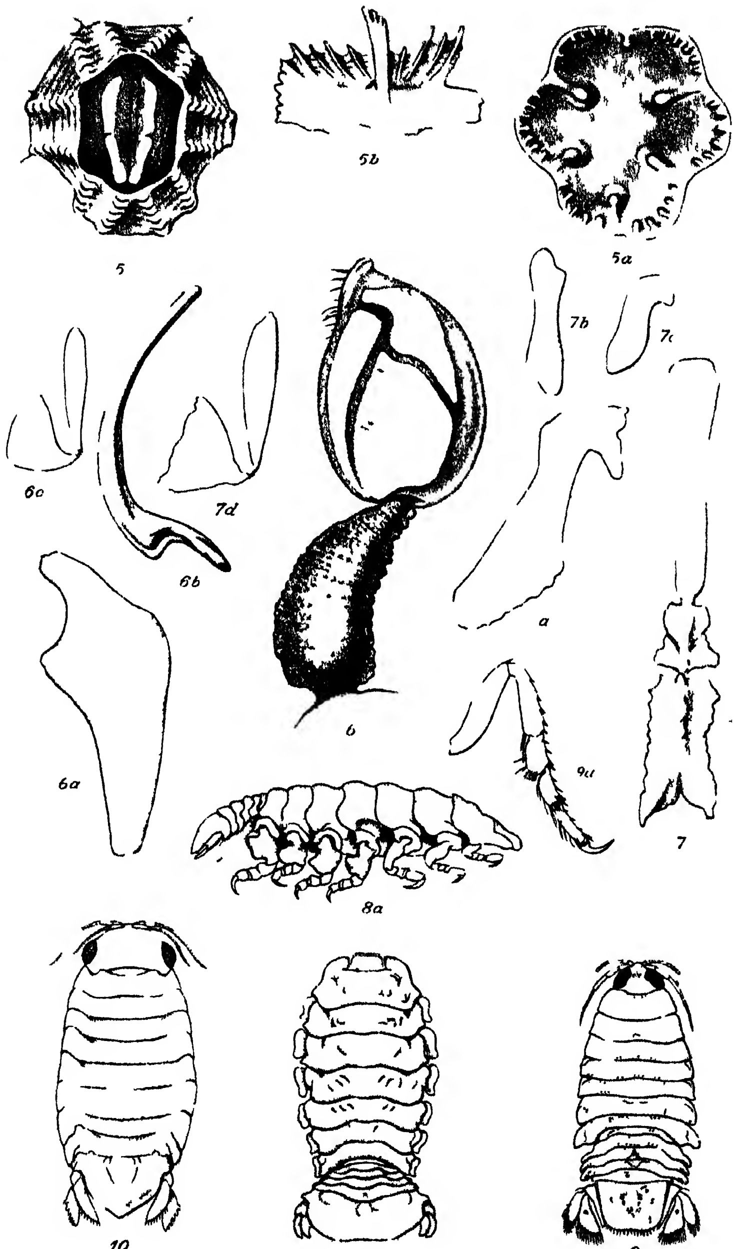
Skull and antlers of male Novaia Zemlian Reindeer (*Rangifer tarandus pearsoni*), from the type specimen in the possession of Mr. Pearson.

wintering on the island. Mr. Pearson adds that in 1897 he saw on the east side of Novaia Zemlia one or two pairs of cast antlers with brow- and bez-tines nearly as large as those of the type specimen.



Edwin Wilson Cambridge

CRUSTACEANS FROM THE MALAY PENINSULA



Edwin Wilson, Cambridge

CRUSTACEANS FROM THE MALAY PENINSULA

3. On the Crustacea collected during the "Skeat Expedition" to the Malay Peninsula. By W. F. Lanchester, M.A., King's College, Cambridge[1].

[Received October 14, 1902.]

(Plates XXXIV. & XXXV.[2])

Part II.[3]—ANOMURA, CIRRIPEDIA, and ISOPODA.

The species represented in the above-mentioned groups, in this collection, number 35 (not including the land Isopods), comprised in 20 genera; of these 6 species are described as new, 2 among the Anomura and 4 among the Cirripedia; in addition to which I have given names, among the Anomura, to one colour-variety, and, among the Cirripedia, to one subspecies and a colour-variety of that subspecies. In the latter case it will be seen that a single form has been burdened with four names, a proceeding which will not, I fear, find favour with many systematists; I have, however, given my reasons for so doing under the description of the form in question, and will only say here that I have not acted under any preconceived ideas on the general question of a quadrinomial nomenclature, but rather from the exigencies of the special case before me.

Besides the marine Isopods herein described, there are in the collection some 10 species of land Isopods; many of these appeared to me, on examination, to be as yet undescribed. At the same time it seemed to me advisable to have the opinion of a specialist in this difficult group, and I therefore applied to M. Budde-Lund, of Copenhagen, who very kindly undertook to examine the specimens, and who tells me that "several of them are not described, but I have the descriptions and drawings laying by from other collections." These species, then, will be included by M. Budde-Lund in a more general account of the land Isopods of the Malay Peninsula, to be published later on in these 'Proceedings.'

A. ANOMURA.

1. Genus Petrolisthes Stimpson.

1. Petrolisthes speciosus Dana.

Porcellana speciosa Dana, U.S. Expl. Exp. p. 417, pl. xxvi. fig. 8 (1852).

Petrolisthes speciosus Ortmann, Zool. Jahrb. Syst. vi. p. 262 (1892).

Loc. Pulau Bidan, Penang. A female.

[1] Communicated by Dr. S. F. Harmer, F.Z.S.
[2] For explanation of the Plates, see p. 381.
[3] For Part I. see P. Z. S. 1901, vol. ii. p. 534.

2. Petrolisthes boscii Aud.

Porcellana boscii (Aud.), Sav. Descr. de l'Egypte, Crust. pl. vii. fig. 2 (1819).

Petrolisthes boscii de Man, Mergui Crust. p. 217 (1888).

Loc. Pulau Bidan, Penang. A male.

II. Genus Porcellanella White.

3. Porcellanella picta Stimpson.

Porcellanella picta Stm. Proc. Ac. Nat. Sci. Philad. p. 243 (1858); de Man, Mergui Crust. p. 220 (1888).

Loc. Pulau Bidan, Penang. Two specimens.

III. Genus Aniculus Dana.

4. Aniculus aniculus Fabr.

Pagurus aniculus Fabr. Ent. Syst. Suppl. p. 411 (1798).

Aniculus typicus Dana, U.S. Expl. Exp. p. 461, pl. xxix. fig. 1 (1852).

Loc. Kelantan. Two specimens.

IV. Genus Spiropagurus Stimpson.

5. Spiropagurus spiriger de Haan.

Pagurus spiriger de Haan, Crust. Japon. p. 206 (1839).

Loc. —— ? A female.

V. Genus Pagurus Fabr.

6. Pagurus hessii Miers.

Pagurus hessii Miers, 'Alert' Crust. p. 264 (1884); Henderson, Trans. Linn. Soc. (2) Zool. v. p. 419 (1893).

Pagurus similimanus id. 'Challenger' Anomura, p. 59 (1886).

Loc. Pulau Bidan, Penang.

One from *Strombus*, with an anemone fixed in the mouth of the shell, one from *Natica* (both these shells with *Balanus æneas*, vide infra), two from *Murex*.

Loc. —— ? One from *Ranella*.

The antennular peduncles are just longer than the eye-stalks, as stated by Henderson.

7. Pagurus punctulatus Olivier.

Pagurus punctulatus Oliv. Encycl. Méth. viii. p. 641 (1811); Ortmann, Zool. Jahrb. Syst. vi. p. 286 (1892).

Loc. Pulau Bidan, Penang. One large specimen.

Loc. Kota Bharu, Kelantan. A small specimen from *Conus*.

VI. Genus Eupagurus Brandt.

8. Eupagurus lacertosus var. nana ? Henderson.

Eupagurus lacertosus var. *nana* Hend. 'Challenger' Anomura, p. 64, pl. vii. fig. 1 (1886).

An ovigerous female, from *Trochus*.

The absence of the chelipedes in this specimen makes its identification a little uncertain. But the frontal, ocular, and antennal regions have exactly the structure of Henderson's variety, though the ambulatory legs are without the spines on the carpal joints.

VII. Genus Clibanarius Dana.

9. Clibanarius corallinus Milne-Edw.

Pagurus corallinus M.-E. Ann. Sci. Nat. (3) x. p. 63 (1848); Ortmann, Zool. Jahrb. Syst. vi. p. 292 (1892).

Loc. Kota Bharu, Kelantan. Two small specimens.

10. Clibanarius æquabilis var. merguiensis de Man.

Clibanarius æquabilis var. *merguiensis* de Man, Mergui Crust. p. 247 (1888).

Loc. —— ? Two specimens.

11. Clibanarius longitarsis de Haan.

Pagurus longitarsis de Haan, Crust. Japon. p. 211, pl. l. fig. 3 (1839); de Man, Arch. f. Naturg. liii. p. 441 (1887).

Loc. —— ? Two specimens, from *Telescopium*.

11 *a*. Clibanarius longitarsis, var. trivittata nov.

Loc. —— ? A male.

This form agrees so entirely in structural peculiarities with the above-mentioned species that it can only be considered as a colour-variety. On the posterior surfaces of the legs there are three broad white bands (broader than in *C. striolatus*), and three slightly narrower red bands; on the anterior surfaces there are two white and two red bands, the banding, however, being much less definite.

12. Clibanarius striolatus Dana.

Clibanarius striolatus Dana, U.S. Expl. Exp. p. 463, pl. xxix. fig. 3 (1852); Ortmann, Zool. Jahrb. Syst. vi. p. 290 (1892).

Loc. Pulau Bidan, Penang. A female, from *Strombus*.

Loc. —— ? Seven specimens from *Cerithium*.

Loc. Patani. One specimen from *Murex* with *Balanus amphitrite*.

VIII. Genus Diogenes Dana.

13. Diogenes planimanus Henderson.

Diogenes planimanus Henderson, Trans. Linn. Soc. (2) v. p. 416, pl. xxxix. fig. 5 (1893).

Loc. —— ? Three specimens from *Murex*, with anemones.

Loc. Patani. Five specimens from *Natica*, with anemones.

The flagella of the antennæ are fringed along their whole length with longish hairs; this point is not noticed by Henderson in his description or figure.

14. DIOGENES RECTIMANUS Miers.

Diogenes rectimanus Miers, 'Alert' Crust. p. 262, pl. xxvii. fig. C (1884).

Loc. ——? One small specimen from *Murex*, and several, very small, from shells of *Rissoa*, *Gibbula*, and *Neritina*.

The largest specimen has the carapace only $4\frac{1}{2}$ mm. long, and large chelipede only 9 mm. long: to their small size it is probably due that the spines on the lower border of the hand of the larger chelipede are scarcely prominent, while the arrangement of the granules on this leg is more obscure.

15. DIOGENES SENEX Heller.

Diogenes senex Heller, 'Novara' Reise, Crust. p. 85, pl. vii. fig. 3 (1865).

Loc. Pulau Bidan, Penang. A female, with ova, from *Murex*.

I cannot discover the ophthalmic process in this specimen, but it is probably safer to consider it as having been accidentally broken off, for otherwise the resemblance of the specimen to Heller's description and figure is complete: the hands only of the larger chelipede and the ambulatory legs would seem to be even more densely hairy than as shown in his figure.

16. DIOGENES DESIPIENS, sp. nov. (Plate XXXIV. figs. 1, 1 *a*.)

Loc. Pulau Bidan, Penang. A male, from *Cancellaria*.

This species is characterized at first sight by its extremely short, broad ophthalmic process, and the great hairiness of the legs and under surface of the body.

The anterior portion of the carapace just behind the front (which is raised into a smooth distinct ridge) is covered with large, coarse, somewhat scattered granules over a small area; behind this area is a deep, transversely-placed groove, convex towards the front and not continued towards the lateral margins, behind which groove the carapace is smooth, except for the very narrow portion enclosed within the groove, which is coarsely punctate. The sides of this part of the carapace are thickly hairy, and rough granulate (almost rugose posteriorly) beneath the hairs; the branchial regions are somewhat swollen, smooth, with a few longish hairs; the V-shaped suture of the gastric region is distinct. The rostrum is bluntly pointed, triangular, with a broad base, and reaches as forward as the lateral teeth; between these and the rostrum the front is concave.

The ophthalmic scales are longer than broad, and rounded distally where they carry some long hairs; the ophthalmic process is short and broad, reaching barely halfway along the scales, with its anterior edge microscopically denticulate. Ocular peduncles

long and slender, as long as antennular, much longer than antennal, peduncles. The antenna is very short, the peduncle (armed with long hairs) a little longer than half the eye, the flagellum only overreaching the eye by half its own length, thinly ciliated. The antennal scale is a broadish ovoid plate, fringed with long hairs, and falling short of the end of the antennal peduncle by some little distance.

The chelipedes are subequal, the right being slightly the larger; in other respects they are quite similar. The whole leg is very hairy, except on the inner surface, and a part of the outer surface, of the merus, the hair being very dense on the outer surfaces of the carpus, hand, and fingers, slightly less so on their inner joints. In the merus, the outer surface bears a few separate granules, the inner is smooth; both lower and outer margins are denticulate, the lower more distinctly so. The carpus carries a row of four large teeth on its upper margin, of which the 3rd, counting proximo-distally, bears a secondary tooth at its base internally; on its outer surface is a row of 5–6 teeth of varying size: between these two rows the carpus is somewhat hollowed proximally, and distally it bears, close to the joint, a small patch of low teeth. The hand is short and very swollen, especially on its inner surface, not longer than the fingers: its outer surface and upper and lower margins carry a few tubercular spines in three irregular rows, the row on the outer surface being the least definite: the fingers are everywhere (except their inner edges) covered with coarse, large granules, the tips corneous, faintly excavate. The ambulatory legs are densely hairy on their upper and lower margins, otherwise smooth; the dactyli a little longer than the penultimate joint.

17. DIOGENES MIXTUS, sp. nov. (Plate XXXIV. figs. 2–2 *b*.)

Loc. Pulau Bidan, Penang. Numerous examples from *Natica*, *Murex*, and other shells.

Loc. Patani. One from *Murex*.

This species is closely allied to *D. miles* Fabr., *D. merguiensis* de Man, and *D. intermedius* de Man; and it has seemed to me best to arrange the main points in which these species agree or differ in tabular form:

D. miles.	*D. merguiensis.*	*D. intermedius.*	*D. mixtus.*
a. *Merus of 3rd legs.*			
Numerous large spines on upper border.	Spines less numerous and smaller.	Spines absent.	As in *D. miles.*
b. *Outer surface of joints of 3rd legs.*			
Numerous small piliferous granules.	Less numerous, larger, and more piliferous granules.	Scarcely granular. Merus nearly smooth.	As in *D. intermedius*, but a row of piliferous granules a little below the upper margin of penultimate joint.

D. miles.	*D. merguiensis.*	*D. intermedius.*	*D. mixtus.*
c. ***Hand and Carpus.***			
Much as in *D. merguiensis*, but tubercles less prominent and more thickly placed. Two rows as in *D. merguiensis.*	Two rows of 11–12 granules, and numerous piliferous acute tubercles on carpus. Palm similar, but the two rows number 8 externally, 5 internally.	Two rows of 11–12 granules, and less numerous granules, with 1–2 hairs at bases only, on carpus. On palm the two rows number 25–27 externally, 10–11 internally.	As in *D. intermedius*, but, on the carpus, the two rows number 14–15 each, and on the palm 10–11 each.
d. ***Fingers.***			
30 granules in the external row.	16–17 granules.	25–27 granules.	24 granules.
(?)	The row of granules on the under margin of the immobile finger extends as far as the carpal joint.	Row of granules extends partly on to the hand.	As in *D. merguiensis.*
e. ***Antennal scales.***			
The inner process extends as far as the middle of the penultimate joint.	Inner process extends a little beyond the penultimate joint.	Inner process extends to the anterior ¼ of the penultimate joint.	As in *D. intermedius.*

From this table it may be seen that *D. mixtus* combines some of the characters of the other three species with characters of its own in such a way that it is difficult to regard it as a variety of any one of the other species, and necessary to regard it as a distinct, though closely allied form.

IX. Genus Cœnobita Latr.

18. Cœnobita compressus M.-Edw.

Cœnobita compressus M.-E. Hist. Nat. Crust. ii. p. 241 (1837); Ortmann, Zool. Jahrb. Syst. vi. p. 318 (1892).

Loc. Pulau Bidan, Penang. One specimen from *Dolium*, two from *Murex*, one from *Purpura*, and numerous other individuals.

Ortmann's diagnosis is deceptive in so far as the outer surface of the 3rd left leg is not quite smooth in large individuals, but, like the cephalothorax, finely granulated or tuberculated; the short stiff hairs springing from these tubercles in front at the base; the tubercles themselves being sometimes corneous at the tips. The same remark holds good also for some large specimens, in the Cambridge Museum, of *C. rugosus* from Torres Straits. On the last joint, however, in both species, the granulation is confined to the proximal $\frac{1}{4}$ or $\frac{1}{5}$ of the joint. Further, the ridge on the outer surface of the penultimate joint becomes rounder, the larger the individual. No doubt these characters are correlated with age.

19. Cœnobita rugosus M.-Edw.

Cœnobita rugosus M.-E. Hist. Nat. Crust. ii. p. 241 (1837); Ortmann, Zool. Jahrb. Syst. vi. p. 317 (1892).

Loc. Pulau Bidan, Penang. Two females, one with ova. Also another female, from *Neris*, with a small Ascidian attached to the left sides of the 2nd and 3rd abdominal segments.

20. Cœnobita perlatus M.-Edw.

Cœnobita perlatus M.-Edw. Hist. Nat. Crust. ii. p. 242 (1837); Miers, 'Alert' Crust. p. 555 (1884).

Loc. —— ? Three females, from *Murex*.

Miers has noted (*l. c. supra*) the fact that in this species "there is an oblique row of somewhat more elongated tubercles on the upper surface of the palm, occupying the place of the series of oblique ridges in *C. rugosa*"; such an arrangement I find in these three specimens. But the specimens in question being somewhat small, the tubercles on the legs are noticeably less prominent and less pearly than in typical examples; the carapace also is less rugose.

B. CIRRIPEDIA.

X. Genus Balanus da Costa.

21. Balanus amphitrite Darwin.

Balanus amphitrite Darwin, 'Balanidæ,' p. 240, pl. v. (1854).

Loc. Patani. On pieces of wood, var *communis*; on *Murex*, var. *obscurus*; on Lamellibranch shells, var. *niveus*.

Loc. Singora. On Lamellibranch shells, var. *obscurus*, and var. *niveus*.

22. Balanus amaryllis dissimilis, subsp. nov. (Plate XXXIV. figs. 3-3 *c*.)

? *Balanus amaryllis* var. ? Weltner, Arch. f. Naturg. lxiii. 1, p. 270 (1897).

Cf. *Balanus amaryllis* Darwin, 'Balanidæ,' p. 279, pl. vii. fig. 6 (1854); Hoek, 'Challenger' Cirripedia, p. 153 (1883).

Loc. Kota Bharu, Kelantan.

This subspecies is represented here by two distinct forms: one, the subspecies itself, of which there are seven large examples; the other a colour-variety, of which there are several smaller examples, attached to pieces of a Gorgonian. These two forms well illustrate the difficulty, which must sometimes arise, of finding a satisfactory place in the binomial system of nomenclature for certain divergent forms. Thus, in the present instance, No. I., though *closely* allied to the species *B. amaryllis*, yet shows sufficiently divergent structural characteristics to be ranked as a distinct variety, if considered alone. But the presence of No. II. necessitates some sort of modification of this conception; for, while exhibiting the same structural divergence, it also differs in colour arrangement: thus it becomes incumbent to form either a subvariety for No. II., or a subspecies for No. I. And in view of the fairly numerous instances in which Darwin has considered colour differences as of varietal worth (vide, e. g.,

B. amaryllis, amphitrite, improvisus), I have been content to follow him in this respect, and to consider No. II. as a *colour-variety* of No. I., the latter being then necessarily regarded as a *subspecies* of *B. amaryllis.* For my justification in separating this form from *B. amaryllis*, I must refer to the differences about to be described.

No. I. = the subspecies.

This form agrees with *B. amaryllis* in all characteristics, whether in structure of shell or structure of body, except those of the opercular valves. These latter, although agreeing in general shape with those of *B amaryllis*, present the following differences:—

(*a*) The *scutum.*—Articular ridge prominent, with a very slight tendency to be reflexed to the tergal margin (this is better seen in the large specimens of the subspecies than in the smaller specimens of the variety); adductor crest prominent. These differences have been already noted by Dr. Weltner in his useful Catalogue of recent Cirripede species (*l. c. supra*).

(*b*) The *tergum.*—Depressor crests well developed; spur, only half its own width from the basiscutal angle.

I think there is no doubt that, apart from No. II., these differences would entitle No. I. to be considered as a variety of the species, and as such I should have classed it, did I not, as I have said, follow Darwin in considering colour difference of varietal worth, so that these differences must be considered as subspecific.

No. II. = var. *clarovittata.*

Presents the same structural distinctions as the subspecies, and differs in the shell being white with rather closely placed longitudinal hyaline lines.

In one specimen of this variety the basal margin of the tergum is very concave between the spur and the basicarinal angle, while the basiscutal angle is sharp, almost tooth-like; and the basal margin of the scutum presents a broad, shallow notch not far from its basi-occludent angle.

The large specimens are about $1\frac{1}{4}$ in. in greatest diameter of base, and about $1\frac{1}{2}$ in. high; the small barely $\frac{1}{2}$ in. across the base, and $\frac{3}{8}$ in. high.

23. Balanus æneas, sp. nov. (Plate XXXIV. figs. 4–4 *b*.)

Loc. —— ?

Shell white, smooth, not very tall, internally longitudinally ribbed; orifice toothed, but not deeply, large and rhomboidal. Radii reduced and very narrow; basis porous, parietes solid. Scutum with the lines of growth distant, not prominent; articular ridge prominent, extending about halfway down the tergal margin; adductor ridge not prominent. Tergum broad, without any beak; spur short, a quarter of the width of the whole basal margin, placed about two-thirds of its own width from the basiscutal angle, its apex rounded.

Mouth: labrum with 2 teeth on each side of the central notch; mandible with 4 large teeth, of which the first is sharper than, and distant from, the others, and 3 small teeth, of which two are situated at the bases of the 3rd and 4th larger teeth respectively, while the third is close to the lower angle; maxillæ with a straight edge and 7 teeth, of which the two upper and the two lower are a little longer than the others.

XI. Genus CHELONOBIA Leach.

24. CHELONOBIA TESTUDINARIA.

Lepas testudinaria Linn. Syst. Nat. (1767).

Chelonobia testudinaria Darwin, 'Balanidæ,' p. 392, pl. xiv. fig. 1 (1854).

Loc. Kota Bharu, Kelantan. Nine specimens.

XII. Genus PLATYLEPAS Gray.

25. PLATYLEPAS OPHIOPHILUS, sp. nov. (Plate XXXV. figs. 5–5 *b*.)

? *Platylepas* —— ? Darwin, 'Balanidæ,' p. 430 (1854).

Loc. —— ?

Hab. Embedded, not very deeply, in the skin of the sea-snake, *Enhydris curtus*.

Shell depressed, orifice large and ovoid.

Parietes, probably aporous, externally marked with longitudinal ribs which are crossed by transverse grooves, at least in the upper half, giving rise to a beaded appearance; in the lower half the ribs are less obviously broken into beads and project beyond the lower line of the compartment, to the number of three or four on each side of the midrib; they are, however, more pointed than, and not nearly so prominent as, the latter. The midribs of the rostrum and carina are a little shorter than those of the lateral compartments. Internally, the longitudinal ribs are visible in the lower half of the compartment, but in the upper half the shell has thickened considerably, growing inwards nearly to the level of the inner edge of the midrib. Basis only moderately convex. Scuta with the rostral ends narrower than the tergal, rounded, and the outer margins lightly concave; the rostral ends not curved inwards. Terga with the outer margins strongly convex towards the carinal end, these ends being truncate and bent inwards, so as to lie with their margins nearly parallel; scutal ends a little broader than the carinal.

The mouth-parts conform to the characters of the genus and present no specific differences. The rami of the 1st cirri are unequal, but not very much so, the inner exceeding the outer only by its last joint. The penis is long, in one instance twice as long as the whole body from the anterior end of the prosoma to the origin of the penis itself; it gradually tapers to its bluntly truncate apex, the terminal half only with a few scattered,

longish, stiff hairs, the apex with the usual bundle of short bristles.

This species, which Mr. F. F. Laidlaw kindly brought to my notice on an *Enhydris* which he was examining, is possibly identical with one of which Darwin had only a single young and imperfect specimen, taken off Borneo, from the skin of a sea-snake. It agrees in the presence of the "two or three very distinct ridges on each side of the midrib" internally; but I have been unable to satisfy myself, in these small specimens, of the existence of any pores in the parietes, so that an identification with Darwin's form must remain a matter of doubt.

It is clearly marked off from the other two species described by Darwin—(*a*) from *P. bissexlobata* by the subequality of the rami of the 1st cirrus, and (*b*) from *P. decorata* by the very moderate convexity of the basis. Moreover, to judge from Darwin's figures, the shell and opercular valves would seem to be considerably thinner in our species.

XIII. Genus Ibla Leach.

26. Ibla quadrivalvis Cuvier.

Anatifa quadrivalvis Cuv. Mém. pour servir . . . Mollusq. figs. 15–16 (1817).

Ibla quadrivalvis Darwin, 'Lepadidæ,' p. 203, pl. iv. fig. 9 (1851).

Loc. Pulau Bidan, Penang. Numerous specimens.

XIV. Genus Lepas Linn.

27. Lepas anserifera Linn.

Lepas anserifera Linn. Syst. Nat. (1767); Darwin, 'Lepadidæ,' p. 81, pl. i. fig. 4 (1851).

Loc. Patani. Two specimens.

XV. Genus Dichelaspis Gray.

The following key to the species of this genus is partly based on that given by Hoek in the Report on the Cirripedia collected by the 'Challenger,' and amplified by Stebbing in the 'Annals and Magazine of Natural History,' (6) xv. p. 21 (1895); but I have modified it somewhat in Group B, owing to the relatively larger number, namely eight, of new species which now have to be included in that group.

A. Carina terminating in a disk.	
Basal segment of scutum narrower than occludent.	
Tergum axe-shaped.	
Edge crenate	*D. grayii* Darwin.
Edge smooth	*D. pellucida* Darwin.
Basal segment twice as broad as occludent	*D. warwickii* Darwin.
Basal segment thrice as broad as occludent.	
Tergum narrowing anteriorly	*D. antiquæ* Stebbing.
Tergum widening anteriorly	*D. hoeki* Stebbing.

B. Carina terminating in a fork.	
Terga absent.	
Basal segment broader than occludent and of the same length	*D. cor* Auriv.
Basal segment narrower than occludent and shorter.	
Basal at right angles to occludent . .	*D. aperta* Auriv.
Basal at obtuse angle to occludent, then parallel to fork of carina	*D. cuneata* Auriv.
Basal segment absent	*D. angulata* Auriv.
Terga present.	
Basal segment broader than occludent.	
Tergum with three teeth .. .	*D. alata* Auriv.
Tergum shaped like a horse's head and neck	*D. equina*, sp. n.
Basal segment narrower than occludent.	
Basal half as long as occludent, or less.	
Tergum triangular .	*D. aymonini* Lessona.
Tergum with carinal edge rounded, scutal edge with 2 lateral teeth	*D. neptuni* Macdonald.
Basal more than half as long as occludent.	
Tergum with 2 teeth.	
Teeth nearly equal .	*D. sinuata* Auriv.
Teeth very disproportionate	*D. trigona* Auriv.
Tergum hook-shaped, handle broad.	
Hook large and blunt	*D. lowei* Darwin.
Hook small and sharp	*D. darwinii* Filippi.
C. Carina terminating in a cup.	
Scutum in two distinct segments.	
Basal narrower than occludent, tergum with 5 unequal teeth .	*D. orthogonia* Darwin.
Basal broader than occludent, tergum with 3 teeth	*D. occlusa*, sp. n.
Scutum with a notch only and indistinctly divided.	*D. sessilis* Hoek.
D. Carina absent . .	*D. bullata* Auriv.

28. Dichelaspis occlusa, sp. nov. (Plate XXXV. figs. 6–6 *c*.)

Loc. Kelantan; Trengganu.

Hab. Mouth-parts of *Thenus orientalis.*

The valves in this species are all very closely apposed, much more than in any other species of the genus. The carina extends between the terga by quite $\frac{1}{3}$ of its own length, is rather strongly curved, and has its anterior end expanded, cup-shaped, and embedded in the peduncle. The scutum consists of two segments, of which the occludent is longer than the basal by barely $\frac{1}{6}$ of its own length, has its tergal margin bluntly rounded, and is united at its rostral end to the basal segment by a narrow bridge of non-calcified tissue; while the basal is $2\frac{1}{2}$ times the breadth of the occludent and separated from it only by a very narrow membranous interspace, and is faintly hollowed on its curved carinal margin close to its tergal angle for the reception of the tip of a strong tooth on the tergum. Between this latter tooth and its occludent angle, the tergum is deeply hollowed where it fits round the end of the occludent segment of the scutum; the scutal margin thus appears tridentate.

The capitulum is rather flattened from side to side; the peduncle differs in appearance in the adult and young forms, being in the former swollen, a little shorter than the capitulum, and brown in colour; and in the latter not swollen, a little longer

than the capitulum, white and semi-transparent; in both, however, it is thickly studded with minute chitinous papillæ (as in *D. warwickii*).

The 1st cirrus is only ⅔ of the length of the 6th, is distant by the thickness of its own pedicel from the 2nd, and has its rami equal; the rami also of the other cirri are equal. The caudal appendage is exactly as long as the pedicel of the 6th cirrus, but appears longer to the naked eye owing to the presence, at its tip, of numerous hairs as long as the joint itself.

As regards the mouth-parts, the outer maxillæ are ovoid, with their inner sides folded over outwardly and their outer surfaces covered with longish hairs; the inner maxillæ each present an incision on their border by which are formed two low step-like projections, the inner being the smaller, and each bears 13 spines, of which the one at the inner angle is much stouter than the rest. The mandibles have 5 teeth, the strongest of which forms the inner angle. The palpi are bluntly conical, with hairs along their outer edges.

The penis is rather thick, and only begins to taper just before its distal end; along its length are several exceedingly short hairs.

This species seems to me to bridge over the narrow gap between the genera *Dichelaspis* and *Pæcilasma*, in relation on the one side with the Dichelaspids generally, and on the other side with *Pœcilasma tridens* Auriv. in particular. My grounds for placing it in the former of the two genera are (*a*) the connection between the two portions of the scutum, and (*b*) the extension of the carina between the terga; these two points clearly bring it within Darwin's definition of his genus. At the same time, the bridge of tissue connecting the two parts of the scutum is extremely narrow, so that I was, for some time, for considering the two portions as separate valves and for referring the species to the genus *Pœcilasma*; while, on the other hand, the carina in *Pœcilasma tridens* also extends between the terga, though only by ⅙ of its length. This species, moreover, has a point in common with those of *Pœcilasma*, and differing from those of *Dichelaspis*, namely, the close apposition of the valves.

But its relationship with both these genera is clearly shown, on the one hand, by the yet present connection between the two parts of the scutum and the extension of the carina between the terga; and, on the other hand, by the almost complete severance of the scutal segments and the close apposition of the valves. And though its possibly closer relationship to one of these genera relieves me of the responsibility of uniting two genera which Darwin separated after the study of a greater number of species, still I feel that there can be little doubt but that the tie between these genera is exceedingly close.

There are also some specimens taken from the extreme base of the chelipedes and from the long epipodite of the 3rd maxillipeds of *Neptunus gladiator*. On the same crab were the specimens of the species next described.

29. Dichelaspis equina, sp. nov. (Plate XXXV. figs. 7–7 *d.*)

Loc. Trengganu.

Hab. Bases of antennules, antennæ and legs, and posterior border of carapace of *Neptunus* (*Amphitrite*) *gladiator*.

The carina in this species is formed of two pieces—a quite short basal portion, and a much longer tergal portion, each of which abuts closely on the other by a small median tooth; these two pieces can be separated readily by caustic potash. In the basal portion the base, embedded in the peduncle, is somewhat widened and forked, but the prongs of the fork are not very prominent; the tergal portion, quite narrow where it abuts on the basal, gradually widens towards its distal end which is squarely rounded.

The scutum consists, as usual, of two parts, connected by a bridge of tissue semicalcified on its occludent side, completely calcified on its basal side (fig. 7 *d*). The occludent segment is nearly twice as long as the basal (= 5·25 mm.: 3 mm.) and has its apex rounded; the basal segment is twice as broad as the occludent at the middle of its length, three times as broad along its basal margin, and is produced at its rostral angle into a blunt, almost tooth-like process, forming the half-bridge of calcified tissue mentioned above. General shape subtriangular, with rounded angles; its basal and tergo-lateral margins are somewhat convex, the occludent somewhat concave.

The tergum has rather the shape of the head and neck of a horse with forwardly-directed ears (whence the specific name)—the base of the neck lying between the apices of the occludent segment of the scutum of the carina; the top of the head forming the upper, the back of the neck the lower carinal margin; and the snout forming a strong tooth projecting in the direction of the scutum, and the forehead forming the occludent margin.

The 1st cirrus lies close to the 2nd, but yet a little more distant than the rest are from each other; the rami of each of all the cirri are equal; the 1st cirrus is only a little more than half the length of the 6th. The caudal appendage is as long as the 1st joint of the pedicel of the 6th cirrus; it carries hairs at its apex, of which the longest are about half the length of the joint, and also distant bundles of 2–3 longish hairs along the outer margin. The penis is just shorter than the 6th cirrus, thick, but tapering suddenly at the tip, with an excavation at the base, at the distal angle of which excavation is a blunt tooth-like prominence, nearly as high as the excavation is deep; this prominence is set within a shallow hollow within the excavation. The penis also, besides the hairs at its tip, bears along its length scattered hairs, some short and stiff, others long and more flexible; rings very distinct.

The palpi are bluntly conical, with longish hairs at the tip. The mandible has five teeth, the one at the inner angle being the strongest, and the one at the outer angle very small and blunt, lying close to the 4th tooth at its outer base.

The outer maxilla has a deep incision in its edge, at the bottom of which is a spine, externally to it three spines, and internally seven spines; the inner maxilla is ovoid, with long hairs on its outer surface.

The peduncle is equal to, or sometimes a little shorter than, the capitulum in length.

VARIATIONS.

This species is very variable in external appearance, one or two of the specimens appearing at first sight to be specifically distinct; but I have no doubt, from a comparison of all the specimens here present, that they are all of one species. These variations are connected with differences in the structure of the membrane, and the form and shape of the valves.

(i) *The Membrane.*

The membrane varies, both in the peduncle and capitulum, from the one extreme, in which it is thin, whitish, and translucent, to the other, in which it is thick, brown (in formol), and opaque, with the valves almost invisible; transitional stages connect these two extremes.

(ii) *The Valves.*

The tergum is generally shaped like the head and neck of a horse, as described, and formed of a single piece, but varies to the extreme shown in fig. 7 *b*. In two young forms also, with transparent membrane, the head proper is reduced and the neck thickened, giving an appearance as in fig. 7 *c*. In one specimen the base of the neck is formed of a very small separate double piece.

The scutum is generally as described; but the basal segment, generally as high as wide, is sometimes less developed, and is then much wider than it is high. The basal segment is also very variable in the number of pieces of which it is formed, thus:—

Individual specimens: basal segment of scutum:

(*a*) Very small, calcified separate portions are present—one at the baso-lateral, and two others at the tergal, angles.

(*b*) Formed of two pieces—a small umbonal, and a large distal (tergal).

(*c*) Formed of three distinct pieces—(1) a relatively small piece round the umbo of the valve; (2) a large piece, including the basal, and a little more than half of the tergo-lateral, margins; (3) a piece, intermediate in size, including the rest of the tergo-lateral, and the whole of the occludent, margins. The line of the tergo-lateral margin is markedly irregular.

(*d*) On the right side (in relation to the animal) of three pieces as in *c*; on the left side of two pieces, a large umbonal and somewhat smaller distal (tergal), the suture between them running irregularly from the middle of the tergo-lateral, to the middle of the occludent, margins. The carina is constantly formed of two

pieces, of which the distal (tergal) broadens to the blunt distal end.

Affinities.—This species is certainly closely allied to *Dichelaspis warwickii* Gray. The general external appearance is much the same, making allowance for its variability in this species, and the mouth-parts appear to agree essentially with the description of *D. warwickii* given by Darwin (Lep. pp. 121–122). But it differs in the fact that the valves are not thin and translucent, but thick and opaque; in the distal broadening, and division into two parts, of the carina; in the shape of the tergum (despite its variability); and in the fact that the 1st cirrus is not "far removed from the 2nd," and that the rami of the 2nd are not unequal.

Although the shape and fission of the carina is the most constant external feature, I have found it difficult to fix that fact satisfactorily in the specific name; words such as *bicarinata*, *fissicarinata*, or others suggesting rather a reduplication of the carina than a single carina formed of two pieces.

I have, therefore, fixed on the horse-like shape of the tergum, which, though not constant, still evidently represents the typical form of that valve in the species, by which to designate the species; hence the specific name *equina*.

C. ISOPODA.

XVI. Genus Cymothoa Fabr.

30. Cymothoa stromatei Bleeker.

Cymothoa stromatei Blkr. Act. Soc. Sci. Indo-Néerland. ii. p. 35, pl. ii. fig. 13 (1857).

Loc. —— ? *Hab.* "Mouth-parts of fish, chiefly of Ikan dalam." Six females and a small male.

31. Cymothoa pulchrum, sp. nov. (Plate XXXV. figs. 8–8 *a*.)

Loc. Pulau Bidan. One female.

Eyes invisible, lateral prolongations of the 1st thoracic segment reaching very nearly to the level of the front, which is rounded acuminate. Cephalic segment ¾ as long as broad (4·5 : 6 mm.), superiorly depressed so as to form a shallow pit; 1st thoracic segment the longest, 2nd, 3rd, and 4th a little shorter and subequal, 5th, 6th, and 7th gradually becoming shorter, the 5th not abruptly shorter than the 4th; segments 1–6 rugose, the rugosities becoming gradually less marked on the hinder segments, the 7th smooth; the lateral prolongations of the 1st segment smooth, curved forwards and inwards, bluntly pointed in front. Abdomen abruptly narrower than thorax, the segments gradually increasing in width to the 5th, which is as wide as the last thoracic, and the 6th, which is as wide as the penultimate thoracic, segments. 6th abdominal segment about twice as wide as long (15 : 7 mm.), somewhat excavate in the anterior median line, and slightly

swollen and coarsely reticulate laterally; uropods just shorter than the 6th segment; rami equal, inwardly curved, and narrow, the outer being a little broader than the inner. Distal end of the crest on the last four thoracic legs increasing gradually in height from before backwards; ungues of all the legs curved, moderately long, and increasing in size backwards but only very gradually, so that those of the last pair are only a little longer than those of the first pair.

Length 35 mm.; breadth 17 mm.

XVII. Genus Meinertia Stebbing.

32. Meinertia carinata Schiödte & Meinert.

Ceratothoa carinata Sch. & Mein. Naturhist. Tidsskr. iii. 13, p. 327 (1883).

Loc. Great Redangs. Several specimens.

XVIII. Genus Nerocila.

33. Nerocila sundaica Bleeker.

Nerocila sundaica Blkr. Crust. Ind. Arch. i. p. 26, fig. 4; Sch. & Mein. Naturhist. Tidsskr. iii. 13, p. 9 (1881).

Loc. —— ? A single female.

Although the anal segment and uropods are much damaged, there is no doubt in my mind that this specimen belongs to the above species, presenting as it does three very characteristic features: namely, the swollen basal joints of the first antennæ, the pectination of the 3rd and 6th–7th legs, and the constriction of the ungues of the other legs. In two points, however, it differs; for the median concavity in the anterior margin of the first segment is slightly deeper (not shallower) than the lateral, and the first four abdominal segments are all subequal, the fifth being only very slightly longer.

XIX. Genus Rocinela Leach.

34. Rocinela mundana, sp. nov. (Plate XXXV. figs. 9–9 *a*.)

Tale Sab. "From the gills of a freshwater skate."

Flagellum of 1st antennæ 4-articulate, of 2nd antennæ 12-articulate; eyes distant, reniform, with the anterior end truncate; ocelli fairly large, numerous.

Front bluntly triangular, projecting in front of the eyes, and only just concealing the base of the 1st antenna; 1st thoracic segment longer than the rest, which are subequal, its anterior border trisinuate; epimera small, increasing in size backwards, the last just overlapping, with its blunt point, the posterior angle of the last segment; 1st abdominal segment partly concealed, distinctly shorter than the rest; its posterior border sinuate, those of the rest becoming straighter towards the telson.

Telson with a transverse swelling at the base on each side of

the middle line; these swellings just meet at the middle line, and from their junction proceeds a very short longitudinal median swelling; the rest of the upper surface smooth and slightly convex. Tip of telson extremely blunt. Uropods with ciliate margin; outer rami as long as telson, inner just longer, and twice as broad as the outer.

Anterior legs without teeth, but with a few short cilia; posterior legs with a few short spines along the lower border of the 3rd to the 6th joints; ungues short.

XX. Genus Sphæroma Latr.

35. Sphæroma felix, sp. nov. (Plate XXXV. fig. 10.)

Loc. —— ? Thirteen specimens.

Body gradually widening from the head to the abdomen, the telsonic portion of which narrows suddenly at the level of the base of the uropods, and thence rather more gradually to the posterior end. Eyes conspicuous, but small. The posterior portion of each of the thoracic segments is marked off from the anterior portion as a raised, broadish, transversely-grooved ridge; the anterior portion, which is smooth, slides, in extension, under the raised portion, which is finely, but rather widely, granulate, as is also the cephalic segment. On the abdomen, and the upper surface of the inner rami of the uropods, the granules are larger, placed more thickly, and concealed under a rather dense, but very short, pubescence. The telson, from the base of the uropods, is bluntly triangular, with its margin non-granulate and reflexed upwards; the inner ramus of the uropods is a little longer than the telson, the outer a little longer than the inner, with its upper surface smooth, and its outer edge fringed with short hairs and bearing 8 small teeth.

A List of the Terrestrial Isopods.

By M. Gustav Budde-Lund.

1. *Ligia exotica* Roux.—Several specimens; Kamlon, Singapore.

2. *Trichoniscus antennatus*, n. sp.—A few specimens of this little species (circa 5 mm. long), without information as to the locality. Distinguished by the very long and slender antennæ, which have a long flagellum, 15-articulate; the antennæ also, especially the first joint, are proportionally long. The uropods have the basal joint, and the exopodite, long and thick, the endopodite very thin.

3. *Philoscia truncatella*, n. sp.—Two specimens, both with damaged antennæ and uropods, from Gunong Inas, Perak, 5000 ft. Seems to be allied to *P. truncata* Dollf., from Celebes and Flores, but the last segment of the truncus is obliquely truncate only on the inside of the epimere; also the transverse line on the epistome is a little sinuate, forwardly, in the middle. Another small,

damaged, specimen, from rotten wood at Ajenz (? Aring, W. F. L.), Kelantan, perhaps also belongs here.

4. *Philoscia incurva*, n. sp.—Only one specimen, without the uropods and with damaged antennæ, from Patalung. Differs from the other Asiatic species in the proportionally well-developed epimera of the caudal segments, which are acute and produced outwardly and backwardly; the last segment of the truncus has the hind margin very deeply incurvated.

5. *Alloniscus brevis* B.-L.—Many specimens from Patalung; a single specimen from Pulau Bidan, Penang.

6. *Alloniscus* sp. — Only one specimen of a little Oniscoid Isopod taken at Bukit Besar. It is without the uropods, and seems to be akin to the *Alloniscus albus* Dollf. from Sumatra.

7. *Metoponorthus pruinosus* Brandt.—Eight specimens among specimens of *Armadillo murinus* Br. from Patani.

8. *Lyprobius* sp.—Only one specimen from Patani. This species is perhaps not different from *L. cristatus*, a species which is found in most tropical parts. I think also that *Porcellio sundaicus* Dollf., from Sumatra, Java, and Celebes, belongs here; and that *P. pallidipennis* Dollf. from Flores, and *P. modestus* Dollf. from Saleyer, should certainly also be included in this subgenus.

9. *Toradjia conglobator*, n. sp.—Three specimens from rotten wood at Ajenz (? Aring, W. F. L.), Kelantan. I know several species of this genus, in which M. Dollfus has included three species—*T. celebensis* Df., *T. gorgona* Df., and *T. cephalica* Df. The *Perysciphus weberi* Df. may be placed here, and *T. conglobator* is most nearly allied to this latter species, the first segment of the truncus not being split in the posterior edges, and the epistome being plain. The antennæ are shorter than in *T. weberi*, with the flagellum short, white, and basal joint very short.

10. *Armadillo murinus* Brandt. — Several specimens from Patani.

11. *Armadillo infuscatus*, n. sp.—Several specimens from Goah Janat. This species and the next belong to the group of which *A. murinus* is the type, having the epimera of the truncus without folds in the hind margin of the first segment. This species is rather larger than *A. murinus*, and has the endopodite of the uropods much longer than in that species. The colour is a dirty pale yellow.

12. *Armadillo pallidus*, n. sp.— Six specimens from Bukit Besar. Very like *A. infuscatus*, but well separated by the form of the telson, which is not so strongly narrowed in the middle, and has the apex much longer than the basis; the basal joint also of the uropods is narrower.

13. *Spherillo grisescens*, n. sp.—Several specimens from Aring, Kelantan. This little species (5 mm. long) is remote from all

hitherto described species, but allied to several new species I have seen. It has some affinity with *S. ambitiosus* B.-L., but has a little fold in the hind edge of the first segment of the truncus: the apex of the telson is quadrangular, not narrowed in the middle, and the exopodite of the uropods scarcely visible.

[I have slightly modified, or occasionally condensed, the language of these descriptions kindly supplied me by M. Budde-Lund.—W. F. L.]

EXPLANATION OF THE PLATES.

PLATE XXXIV.

Fig. 1. *Diogenes desipiens* (p. 366). Antennal region. 1 *a*. Left chela.
2. *Diogenes mixtus* (p. 367). Antennal region. 2 *a*. Chela. 2 *b*. 3rd left leg.
3. *Balanus amaryllis dissimilis* (p. 369). 3–3 *a*. Scutum. 3 *b–c*. Tergum.
4. *Balanus æneas* (p. 370). From above. 4 *a*. Scutum. 4 *b*. Tergum.

PLATE XXXV.

Fig. 5. *Platylepas ophiophilus* (p. 371). From above. 5 *a*. From below. 5 *b*. A lateral compartment, seen from the inside.
6. *Dichelaspis occlusa* (p. 373). From the side. 6 *a*. Tergum. 6 *b*. Carina. 6 *c*. Scutum.
7. *Dichelaspis equina* (p. 375). Carina. 7 *a*. Tergum, typical form. 7 *b–c*. Two different forms of the tergum. 7 *d*. Scutum.
8. *Cymothoa pulchrum* (p. 377). From above. 8 *a*. From the side.
9. *Rocinela mundana* (p. 378). From above. 9 *a*. Posterior leg.
10. *Sphæroma felix* (p. 379). From above.

4. On a Collection of Dragonflies made by the Members of the "Skeat Expedition" in the Malay Peninsula in 1899–1900. By F. F. Laidlaw, B.A.

[Received November 18, 1902.]

Part II.[1]

Cœnagrioninæ.

In dealing with the last of the subfamilies represented in this collection, I have attempted as before to give a complete list of species hitherto recorded from the Peninsula. This list will shortly prove to be incomplete, for I have in my hands awaiting examination a fine collection of Odonata, made by Mr. Annandale, who has revisited the Peninsula; and, from a casual inspection of his specimens, it is evident that it includes a number of species which are, if not new to science, at any rate new to the Peninsula. Further, I am informed by Dr. Foerster, to whom I am much indebted for kind assistance and courtesy, that he has recently received a large consignment of Odonata from the same locality, including new and remarkable forms.

I venture to hope, however, that the present list may none the less be of some service.

I take the opportunity of correcting two or three errors, of which I find I have been guilty in the first part of this account.

[1] Part I., see P. Z. S. 1902, i. p. 63.

Firstly, in dealing with the sexual characters of *Tetrathemis*, I was not acquainted with a paper of Dr. Foerster's published in the 'Természetrajki Füzetek' (1900, pp. 81–108), where, in describing two new species of this genus from New Guinea, he calls attention to the peculiar differences between the armature of the femurs of the two sexes. Secondly, he has pointed out in a letter that the forms which I identified as *Gynacantha rosenbergi* Brauer probably do not belong to that species, which does not occur west of Banda. My specimens are perhaps referable to *G. basiguttata*, but I have not had the opportunity of re-examining them.

Lastly, in my description of *Gomphus consobrinus*[1] (P. Z. S. 1902, vol. i. p. 80), "Type A of Selys" should read "Type B of Selys," whilst *Echo tricolor* Krüger, on page 85, should be altered to *E. iricolor* Krüger.

(Species marked with an asterisk are not included in our collection.)

Legion Lestes.

LESTES RIDLEYI Laidlaw.

Lestes ridleyi Laidlaw, P. Z. S. 1902, p. 92.

One male from Gunong Inas.

LESTES PRÆMORSA.

Lestes præmorsa Kirby, Cat. Odonata, p. 162; Krüger, Stett. ent. Zeit. 1898, p. 130.

A number of specimens from Kwala Aring.

Concerning this species, I find the following notes in my diary:—Aug. 20th (1899): "I found to-day large numbers of a species of Dragonfly over a pond; I caught several pairs."

Aug. 28th (1899): "I noticed that the species which I had seen so abundantly near the pond had disappeared almost entirely. I have only found it in this one spot."

Legion Podagrion.

*PODOLESTES ORIENTALIS Selys.

Podolestes orientalis Kirby, Cat. Odonata, p. 126; Krüger, Stett. ent. Zeit. 1899, p. 98.

Recorded from Malacca.

*AMPHILESTES MACROCEPHALA Selys.

Malacca.

AMPHILESTES MIMA Karsch.

Amphilestes mima Karsch, Ent. Nachr. xvii. (1891) p. 242; Krüger, Stett. ent. Zeit. 1898, p. 100.

[1] Mr. Calvert has pointed out to me, since this paper was read, that this name is pre-occupied by *Gomphus consobrinus* Walsh = *G. externa* Selys (see Kirby, Cat. Odonata, p. 66). Accordingly, I propose to alter the name to *G. kelantanensis*.

A very beautiful and striking species. I believe that the female has not as yet been described; it differs markedly from the male and is fully as brightly coloured. I append a short description of it:—

♀. Head, prothorax, and thorax nearly as in the male, the yellow rather less vivid, and the black stripes on the upper lip and epistome continuous with the black markings near the base of the antennæ.

The abdomen is chestnut-brown above, but the first segment is yellowish green. Segments 2-6 each with a black apical ring feebly developed on the second segment. Immediately before the apical ring there is on each of these segments a dorsal yellowish-green mark, extending forward in 2–3 for about one-half, and in 4-6 for about one-third, of the total length of the segment. This mark is divided longitudinally in each segment by a thin brown line on the mid-dorsal carina.

In segments 3–6 the black apical ring sends forward on either side of the segment a black line, extending nearly the whole length of the segment.

In the seventh segment the anterior half is black, and the yellowish-green marking here is divided into two parts, well separated from each other and diverging posteriorly, the space between them being occupied by a triangular extension forward from the apical ring, which also sends forward, as in the preceding segments, a lateral mark on either side. Segment 8 is black dorsally, with a yellowish-green band either side, and beyond these again black lateral lines. Segments 9-10 are black, 9 with a small and 10 with a minute pair of yellowish spots. Under surfaces yellowish brown. Appendages short, yellow, with black tips.

Length of abdomen 30 mm., of hind wing 24 mm.

Several pairs from a stream near Kwala Aring.

Legion Protoneura.

Protosticta foersteri, sp. n.

One female from Gunong Inas, Perak.

Lower lip rounded, with short lobes. A small supplementary basal postcostal nerve present, lying at a level between the base of the wings and the first antenodal costal nerve. Pterostigma trapezoid, dark brown in colour, surmounting a single cell, its anterior margin shorter than its posterior; followed by a single row of cells. Sectors of the arculus united from their commencement for a short distance. Upper sector of the quadrilateral ending against the hind margin of the fore wing at the level of the first postnodal costal nerve; that of the hind wing one cell lower. *No trace of the lower sector of the quadrilateral.* The median sector starts from the nodal vein, the subnodal a little beyond it.

Head black; upper lip and rhinarium bluish white, the former with a black margin; antennæ yellowish.

Prothorax dull yellow, a pair of black spots on either side of the mid-dorsal line on the median and posterior lobes.

Thorax bronze-black above, sides dull brownish yellow, with an indistinct black line along the second lateral suture.

Abdomen black, segments 3–7 with a pale yellow basal ring.

Hinder dorsal half of segment 9 yellow. Segments 2-6 with an indistinct wide yellowish-brown ring lying behind the middle of each segment, save in segment 2 where it occupies the greater part of the segment.

Appendages black.

Legs yellow with long yellow spines, 6-7 pairs of these on the third pair of tibias, directed almost laterally.

Length of hind wing 17·5 mm., of abdomen 30 mm.

This species is the smallest member of its genus. It is of interest geographically, as the other species are recorded from the Celebes and Philippines. It is also of interest because, having its median and subnodal sectors arranged as in those species, it tends to prove that the genus is a natural one and not derived polyphyletically from *Platysticta*.

*PLATYSTICTA QUADRATA Selys.

Singapore.

*DISPARONEURA ANALIS Selys.

Sumatra. Malacca.

*D. INTERRUPTA Selys.

Sumatra. Banca. Singapore.

D. HUMERALIS Selys.

Disparoneura humeralis Kirby, Cat. Odonata, p. 134.

2 ♂, 1 ♀ from Kwala Aring.

In one of the males there is no trace of the lower sector of the quadrilateral on the hinder wings.

♀. Pterostigmata nearly black, paler round the edges. Upper lip and genæ yellowish brown; a stripe of the same colour runs across the vertex. The prothorax has a pair of lateral yellow marks continuous with antehumeral lines of the same colour on the thorax.

Abdomen with the mid-dorsal crest of segments 2-3 yellow. 3-6 with a pair of small lateral yellowish-white spots at their bases. All these markings are on a black ground.

DISPARONEURA COLLARIS Selys.

A single male from Kwala Aring.

CACONEURA GRACILLIMA (Selys)?

A single male from Kwala Aring, very immature, shrivelled, and without segments 7–10 of the abdomen.

No supplementary basal postcostal nerve. Lower lip with short, rounded lobes. Lower sector of quadrilateral entirely absent.

Very slender body. Basal postcostal nerve lying between the level of the two costal antenodal nerves. Upper sector of the quadrilateral of the fore wings not reaching to the first transverse nerve after the quadrilateral; in the hind wing it extends one cell further. 14 postcostal nerves on the fore wing.

Certainly closely allied to *C. gracillima* as described by de Selys, but with the following points of difference:—Upper lip entirely black. Segments 2, 3 of abdomen without a pale dorsal stripe.

C. gracillima is said by Selys to come probably from the Celebes or possibly from Borneo. Kruger (Stett. ent. Zeit. 1898) remarks that the species known hitherto belonging to the "*gracillima*" section of the genus all came from Borneo. He describes a new species belonging to this section from Sumatra. The present specimen is in all probability a representative form of *C. gracillima*, and when better known will most likely require naming as a distinct species.

Legion Platycnemis.

*Trichocnemis membranipes (Rambur).

Singapore. Malacca.

*Trichocnemis octogesima Selys.

Singapore.

Trichocnemis borneensis Selys.

Cœliccia borneensis Kirby, Cat. Odonata, p. 128.

1 ♂, 4 ♀ from Kwala Aring belong, I believe, to this species. Mr. Annandale's collection includes a fine series of insects belonging to this genus; accordingly I prefer to leave these specimens without comment for the present.

*Copera vittata (Selys).

Malacca.

Copera marginipes (Ramb.).

Copera marginipes Kirby, Cat. Odonata, p. 129.

Psilocnemis marginipes Krüger, Stett. ent. Zeit. 1898, p. 101.

Four males and a female from Kwala Aring, Sept. 1899.

These agree closely with Selys's description, but the males have the epistome and genæ largely yellow. The posterior pair of tibias of the males are strongly dilated, and the upper anal appendages are only one-fourth the length of the lower pair.

Copera atomaria (Selys).

Copera atomaria Kirby, Cat. Odonata, p. 129.

Three females and a male, all immature, from Kwala Aring, in September.

The upper anal appendages of the male are fully one-half the length of the lower pair. The second pair of tibias are not dilated, the third pair are unfortunately lost.

Legion Cœnagrion. (*Agrion* of Selys.)

Pericnemis stictica Selys.

Pericnemis stictica Kirby, Cat. Odonata, p. 158; Krüger, Stett. ent. Zeit. 1898, p. 125.

One male from the foot of Gunong Inas.

Length of abdomen (without appendages) ...	55	mm.
„ hind wing	32·5	„
„ appendages (upper pair)...........	1	„

This species is one of the largest and in some respects the most remarkable member of the "legion." It has previously been recorded from Java and Sumatra, but apparently the appendages of the male have not hitherto been described. These, it will be seen, bear a closer resemblance to those of species belonging to the genus *Amphicnemis* than to those of species of *Teinobasis*.

The most striking peculiarity of the species, apart from its large size and extremely slender proportions, is the pentagonal shape of the pterostigma, most marked in the fore wing. The pterostigma is brownish black with a lighter margin, the whole surrounded by a thick black nerve.

Another remarkable feature is the curious "horn" curving upwards and a little forward from the middle of the hinder margin of the prothorax.

The upper pair of appendages of the male are rather slender; they curve inwards and a little downwards. They are black at the base, but for the greater part of their length dull yellow. Each bears rather beyond its middle a small tooth on its upper inner surface.

The lower pairs are shorter and much slenderer; they run nearly straight back, converging slightly. Each at its extremity meets the extremity of the upper appendage of its own side. Coloration similar to that of the upper pair. Both pairs are black at the tip.

Teinobasis kirbyi, sp. n.

A single male, unfortunately much damaged, from Gunong Inas. As it is quite distinct from any described species, it is well, I think, to describe it in spite of its mutilated condition.

Length of hind wings 25 mm.

Wings petiolated to the level of the commencement of the quadrilateral. Claws smooth, without teeth. Inner margin of

the pterostigma more oblique than the outer. Pterostigma black, with pale margin, enclosed by a very thick black nerve. Median and subnodal sectors united by a common stalk from their origin as far as the first transverse nerve they encounter (on the right fore wing beyond it for a short distance). Posterior tibias with four pairs of black spines.

Upper surface of the head dark green, upper lip dull bronze, nasus black, antennæ brown, postocular surface dirty white. Prothorax dull brown, dorsal surface of thorax bronze-green, sides and under surface greyish white, pruinose.

Abdomen (segments 1–7 only) bronze-black above, dull dark brown below.

Allied to *T. superba* from the Celebes and Moluccas. It differs in details of coloration and in having only four spines on the posterior tibias.

*TEINOBASIS RUFICOLLIS (Selys).

*ARCHIBASIS MELANOCYANA (Selys).

ARGIOCNEMIS RUBEOLA Selys.

Argiocnemis rubeola Kirby, Cat. Odonata, p. 153.
Race *sumatrana*? Krüger, Stett. ent. Zeit. 1898, p. 126.
1 ♂ from Khota Baru, Kelantan.

ARGIOCNEMIS NIGRICANS Selys?

Argiocnemis nigricans Kirby, Cat. Odonata, p. 158; Krüger, Stett. ent. Zeit. 1898, p. 126.

4 ♂, 1 ♀ from Khota Baru, Kelantan.

Like Krüger's specimen, mine are rather larger than Selys's.

Length of hind wing, ♂ 15, ♀ 16 mm.
,, abdomen, ♂ 27, ♀ 26 ,,

Postnodal nerves from 9 to 18 on the fore wing. The middle lobe of the prothorax rather truncate, not rounded.

The males differ from Selys's description in having segments 8–9 of the abdomen of a dull-brown colour (probably blue in the living insect), whereas in the male described by Selys there is a trilobed blue mark on the eighth segment. Otherwise the agreement is fairly close. It should be remarked, however, that the colour-pattern of my four male specimens shows no variation. The female is exactly like that described by Selys as the female of *A. nigricans*. I am disposed to think that the female described by Selys as belonging to *nigricans* did not belong to the same species as the male. His measurements suggest this. They are:—

Length of abdomen, ♂ 22, ♀ 25–28 mm.
,, hind wing, ♂ 15, ♀ 17–19 ,,

If I am right, then, in taking this view, it follows that the female of the true *A. nigricans* is as yet unknown, whilst my specimens belong to a distinct species, differing from *A. nigricans*,

so far as the male is concerned, in being somewhat larger, in having segments 8–9 of the abdomen blue or brownish blue, and in addition having a black epistome, and no black carina on segment 1.

It is, however, scarcely advisable to name this supposed new species until definite evidence as to the female of the typical *A. nigricans* is forthcoming.

See also Selys, Ann. Mus. Gen. (2) x. 1890, and Ris, Arch. f. Naturg., Jahr. 66, Bd. i. p. 200.

*Agriocnemis minima Selys.

Agriocnemis minima Kirby, Cat. Odonata, p. 151; Krüger, Stett. ent. Zeit. 1898, p. 126.

Collected by Dohrn in Penang.

Agriocnemis incisa Hagen.

Agriocnemis feminina Kirby, Cat. Odonata, p. 158.

Agriocnemis incisa Krüger, Stett. ent. Zeit. 1898, p. 127; Ris, Arch. f. Naturg., Jahr. 66, Bd. i. p. 200, pl. x. fig. 19 (1900).

Two males and a female of the orange variety from Khota Baru, Kelantan.

The rose-colour of the latter only extends to the fifth abdominal segment.

Agriocnemis pulverulans Selys.

Agriocnemis pulverulans Kirby, Cat. Odonata, p. 158; Krüger, Stett. ent. Zeit. 1898, p. 127.

4 ♂ from Khota Baru, Kelantan.

The members of the above genus are the smallest known Odonates. The length of the hind wing of a male of *A. incisa* is 9 mm. and of the abdomen 16 mm. Both this and the preceding genus (*Argiocnemis*), as well as the two following, are found, so far as my experience goes, chiefly in cultivated low-lying land near the coast. Certainly I never saw specimens of any of them "up-country," whilst in the big rice-fields about Kelantan and Tringganu they are the only Cœnagrions that are at all abundant.

*Onychargia atrocyana Selys.

Singapore.

*Onychargia vittigera Selys.

Singapore.

Pseudagrion microcephalum Ramb.

Pseudagrion microcephalum Kirby, Cat. Odonata, p. 153.

3 ♂ from Tringganu.

Ceriagrion cerinorubellum (Brauer).

Penang. Sumatra. Ceylon.

CERIAGRION ERUBESCENS Selys.

Ceriagrion erubescens Krüger, Stett. ent. Zeit. 1898, p. 127.

Ceriagrion coromandelianum, race *erubescens* Selys, Ann. Mus. Gen. (2) x. 1890.

3 ♂, 1 ♀ from Khota Baru, Kelantan. Recorded from Sumatra and Burmah.

5. On a new Species of Marine Spider of the Genus *Desis* from Zanzibar. By R. I. POCOCK, F.Z.S.

[Received November 18, 1902.]

(Text-figure 78.)

In a monograph of the marine Spiders of the genus *Desis*, published in the Society's 'Proceedings' for 1902, vol. ii. pp. 98-106, I drew attention to the fact that, so far as was then known, these Spiders existed only upon the coasts of Cape Colony and of the countries of Austro-Malaya, and commented upon the absence of any record of their occurrence along the miles of coast-line that intervene between Durban and Singapore.

While this paper was in the press I received from Mr. Cyril Crossland the news that he had discovered a Spider beneath stones between tide-marks while hunting for other marine objects at Zanzibar. It was with great satisfaction that I undertook to determine the Spiders from this new and interesting locality, naturally expecting them to show close affinity to the two known forms from Cape Colony. Much to my astonishment, they proved to be nearly related to the species of the Austro-Malayan type, not even tending in any respect to bridge over the structural interval that separates the S. African from the Malaysian species.

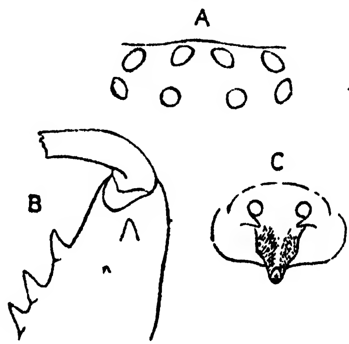
In the paper already referred to, I pointed out that the intermediate form between the two groups of species, namely, the *Paradesis*-group from Cape Colony and the *Desis*-group, in the strict sense of the word, from Austro-Malaya, is represented in Australia by *Desis kenyonæ*; and this fact I suggested furnished evidence in favour of the view that S. Africa had received its representatives of marine Spiders from Australia by means of a trans-oceanic land-connection to the south of the Indian Ocean. This conclusion is in no sense invalidated by Mr. Crossland's discovery of the genus at Zanzibar, because, as already stated, the Zanzibar form stands no nearer to the South-African forms in specific structural features than do those inhabiting the Malaysian seas. The discovery shows conclusively, however, that the North-eastern coast of Africa has received its representatives of *Desis* from the same source whence the Austro-Malayan forms emanated, and renders almost certain the existence of the genus in suitable localities along the shores of Southern Asia westwards of Singapore.

These considerations point to the conclusion that the African species of *Desis* made their way into the country by two routes, one lying to the north, the other to the south of the Indian Ocean.

DESIS CROSSLANDI, sp. n. (Text-fig. 78.)

♀. Colouring like that of the other species of the genus, the mandibles and cephalic region of the carapace deep castaneous; sternum and mouth-parts a little or considerably paler; legs pale ochre, with scopular hairs on tarsi and protarsi fuscous; abdomen testaceous.

Text-fig. 78.



Desis crosslandi.

A. Eyes from above. B. Distal extremity of right mandible from below. C. Vulva.

Carapace about as long as tarsus + protarsus, rather longer than patella + tibia of 4th leg; a little shorter than patella + tibia of 1st and as long as protarsus + $\frac{1}{2}$ the tarsus of this appendage. *Eyes* (text-fig. 78, A) of the posterior line slightly procurved, subequally spaced, the medians only a little farther apart than either is from the lateral, the medians about 2 diameters apart and perhaps $1\frac{1}{2}$ diameters from the laterals; anterior median eyes about a diameter apart and about two diameters from the anterior laterals (in other specimens the eyes appear to be larger and the distances between them consequently less).

Mandibles (text-fig. 78, B): of the two teeth on the postaxial (posterior or outer) border of the fang-groove the distal is much the larger, the space between the two being equal to about three or four times the length of the proximal, and only a little less than the space between the distal and the base of the fang; teeth of the preaxial or inner side of the fang-groove normally seven in number, the first, situated opposite the interval between the two teeth of the outer (postaxial) row, smaller than the second, third, or fourth, which are large and progressively but only slightly

decrease in size towards the proximal end of the mandible; all the teeth evenly spaced.

Legs 1, 4, 2, 3 in length. 1st leg with a superior basal spine on femur, the remaining segments unspined: 2nd leg with superior basal and anterior apical femoral spine, three inferior apical protarsal spines (sometimes one median inferior protarsal spine as well), and one inferior median tarsal spine: 3rd leg with one superior basal and three apical spines on femur, one superior, two or one anterior and two or one posterior, and two inferior apical spines on tibia; one superior, two anterior, two posterior, and five inferior, of which three are apical, on the protarsus, and six inferior spines on the tarsus: 4th leg with one superior basal and one posterior apical spine on femur, two or three posterior, three inferior spines, of which two are apical, on the tibia, and about twelve spines on the protarsus somewhat irregularly arranged as follows two above, two behind, two in front, and three pairs beneath; the tarsus armed with about six spines: the protarsi of the 2nd, 3rd, and 4th legs furnished beneath with a pad of greyish hairs.

Vulva (text fig. 78, C) formed upon the same plan as in the other species of the genus, the median excavation very shallow, the lateral teeth distinct and projecting inwards and downwards, the posterior median angle forming a rounded, smooth, sub-vertical prominence showing a shallow basal constriction.

Measurements in mm.:—Total length 10, carapace 5; 1st leg 15, 2nd leg 11, 3rd leg 13, 4th leg 9·5.

Loc. Zanzibar. "Under stones at low tide" (*Cyril Crossland*).

In a young specimen (about 2 mm. in length) the eyes have the same arrangement as in the adults, but are relatively much larger and consequently closer together; the mandibles are less prominent, and armed below with one outer and four inner teeth; the trochanter of the palp is small, not elongate; the maxillary processes are parallel-sided, lightly convergent, and obtusely rounded at the apex; and the labium is wider than long and almost semicircularly rounded marginally.

In the spacing of its eyes and the spine-armature of its legs this species is allied to *D. maxillosa*, *vorax*, *martensi*, and *marina*, which constitute a group hitherto believed to be restricted in range to the coasts lying between Singapore and New Zealand. Of these four species, the only two known to me are *D. martensi* from Singapore and *D. marina* from New Zealand and Australia. From both of these *D. crosslandi* differs in the form of the vulva and the closer spacing of the eyes. It resembles *D. marina* in the size and spacing of the two teeth on the posterior or outer side of the fang-groove of the mandible; but in *D. marina* the first tooth of the inner row is separated by a relatively wider space from the second than is the case in *D. crosslandi*.

Of the other two species, namely, *D. vorax* from Upolu and *D. maxillosa* from New Guinea, &c., I can only speak with

hesitation, knowing them merely from the published figures and description. *D. crosslandi* apparently differs from both in the dentition of the mandible, the two outer teeth of the fang-groove being apparently equal and widely spaced in *D. vorax*, and close together and unequal in *D. maxillosa*, whereas in *D. crosslandi* they are unequal as in *D. maxillosa* and widely spaced as in *D. vorax*. No doubt other differences will be discovered when examples of the three species are compared side by side.

6. On some new Harvest-Spiders of the Order Opiliones from the Southern Continents. By R. I. Pocock, F.Z.S.

(Text-figures 79–84.)

[Received November 18, 1902.]

The species described in the following pages are based upon specimens in the British Museum. Perhaps the most interesting part of the paper is the section devoted to the Insidiatores, where considerable additions to our knowledge of this group are to be found. The genera known up to the present time are confined to the southern continents—*Diasia* occurring in Chili, *Triænonyx* in Chili and the Fiji Islands, *Nuncia* being from Stephen's Island, New Zealand, *Triænobunus* from Eastern Australia, *Acumontia* from Madagascar, *Larifuga* from Cape Colony, and *Adæum* from Cape Colony and Stephen's Isl., New Zealand. To these I have added *Lomanella* from Tasmania and *Sörensenella* from New Zealand. It is also my good fortune to be able to point out the extension of the genus *Triænobunus* to Tasmania, and of *Triænonyx* to New Zealand and Australia, and to be able to add eight new species to the twelve already described.

It seems superfluous to point out the evidence, supplied by the geographical data quoted above, for the former existence of a land-connection between South Africa and Austro-Zelandia on the one hand, and South America and Austro-Zelandia on the other. The former is attested by the existence of the genus *Adæum* both in South Africa and New Zealand; the latter by that of *Triænonyx* in Chili and Austro-Zelandia. Up to the present time, however, this group of Opiliones supplies no proof of a direct connection between South America and South Africa by means of an antarctic trans-atlantic extension of land.

Suborder PLAGIOSTETHI.

Fam. PHALANGIIDÆ.

Genus PHALANGIUM Linn.

PHALANGIUM LEPPANÆ, sp. n.

Colour variable: greyish brown, often marbled with darker

patches forming a series of spots suggesting the median dorsal band of *P. opilio*; palpi pale, with darker brown stripes on the femur and patella; legs indistinctly annulated, with femora dark brown, the spines white; patella dark below, tibia with an indistinct broad dark band.

♂. *Dorsal integument* closely granular: carapace with a cluster composed of nearly twenty long and strong or shorter and weaker spines in front of the ocular tubercle; some marginal spines as well; one spine on each side near the tubercle, a transverse row of longer and shorter spines behind the tubercle, and a corresponding row on the posterior segment of the carapace and on the five following fused tergal plates; some additional scattered spines on the terga, especially towards the middle line.

Ocular tubercle armed with four pairs of long and strong spines, unequally or subequally spaced, the first rising slightly above the level of the last.

Basal segment of *mandible* shorter than the oculiferous segment of the carapace, reaching as far forwards as the base of the femur of the palp; armed above with some seta-tipped tubercles and externally with about half a dozen strong curved spines; second segment unspined, subparallel when viewed from the front. *Palp* with femur rather strongly tubercular below; tarsus long and arcuate, as long as patella + tibia and perhaps a little longer than the femur. *Legs* with coxæ distally tubercular; trochanters spined externally and internally; femora studded with serially arranged sharp spiniform tubercles; patellæ apically spined above; tibiæ unspined, with flattened dorsal, ventral, and lateral surfaces, the angles being mostly rounded and hairy, not so sharply angular as in *P. opilio* for example.

♀. Larger than ♂; the spines on the carapace (but not on the tubercle[1]), abdomen, and appendages noticeably weaker. *Mandibles* smaller, the basal segment without external spikes or spines.

Measurements in mm.:— ♂. Total length 5; length of chelicera 3, of palp 6; femur of 1st leg 5, of 4th leg 6.

♀. Total length 9; chelicera 3, palp 5; femur of 1st leg 4, of 4th leg 6.

Loc. S. Africa: Teafontein near Grahamstown (*Miss L. Leppan*). Also the young of the same or an allied species from Port Elizabeth (*Dr. R. Broom*).

This species apparently differs from *P. capense* Loman (Zool. Jahrb., Syst. xi. p. 518, 1898), from Matjesfontein, in possessing normally not less than four pairs of ocular spines, instead of three; in having the tarsus of the palp as long as its patella and tibia taken together, instead of only about as long as the tibia; and apparently in the greater length of the legs—*i. e.* the type of *P. capense*, measuring 8 mm. long, has a second leg of nearly

[1] The number of ocular spines is variable; 4 + 4 seems to be the normal, but sometimes an extra small spine is added below in front or behind, so that there are not uncommonly five spines at least on one side. In one example there are six spines on one side and three on the other.

24 mm., whereas a female of *P. leppanæ* measuring 9 mm. has a second leg of 33 mm. in length.

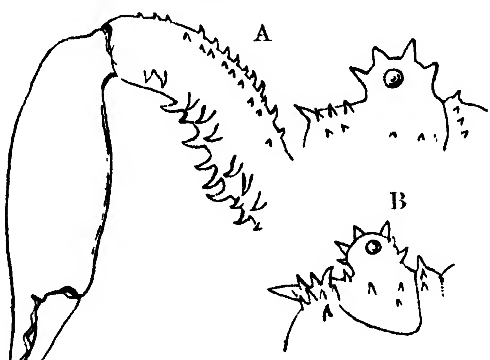
The female of this new species is a genuine *Phalangium*, whereas the male approaches *Rhampsinitus*.

The genus *Rhampsinitus* Simon (CR. Soc. Ent. Belg. 1879, p. lxxii) appears to me to rest upon an insecure foundation. The species I have described below as *Phalangium* (*Rhampsinitus*) *telifrons* and *spenceri* differ from *P. leppanæ* only in the greater length of the mandibles and the greater size of the inferior spines of their basal segment in the male. It is permitted to doubt whether such a character should be granted generic rank.

PHALANGIUM (RHAMPSINITUS) SPENCERI, sp. n. (Text-fig. 79, A.)

Colour of trunk light olive-grey above, with a paler yellowish median longitudinal line, 1 mm. wide, extending from the ocular tubercle with a sinuous darker line external to it; chelicera yellowish brown, indistinctly banded longitudinally, the spines on the basal segment black-tipped above, second segment mottled with darker spots without and within; legs yellowish red, darker apically; coxæ clouded with chalky white; abdominal sterna whitish.

Text-fig. 79.



Phalangium (*Rhampsinitus*) *spenceri*, ♂, and *P.* (*Rh.*) *telifrons*.

A. Carapace and mandible of male *P.* (*Rh.*) *spenceri*, and
B. Carapace of *P.* (*Rh.*) *telifrons*.

Upperside of body finely and closely granular; carapace (text-fig. 79, A) with two pairs of spiniform teeth on each side of the tubercle, a few marginal by Krohn's stigmata, and many on the ante-ocular portion, that on the middle of the front border being conspicuous; the tubercle with *four* pairs of sharp spiniform teeth; a deepish transverse groove, followed by a row of spicules, running to the base of the 3rd leg behind the ocular tubercle; this is followed by six transverse segmental rows of sharp spicules,

the first of which runs to the base of the 4th leg; the remaining four terga without spicules.

Mandibles (text-fig. 79, A) with basal segment arcuate, thickly and strongly spicular above and internally, armed below, both externally and internally, with many long, strong, close-set spines; second segment stout, smooth except for some smallish spicules on the inner side at the base; the digits each with two larger spaced teeth and some smaller ones.

Palpi with a sharp spine at the base of the maxillary process, studded with short, stiff bristles; tarsus long, much longer than tibia + patella, at least as long as femur. *Legs* with femora, and to a lesser degree the trochanters, studded with numerous conical tubercles or spicules; a few also on the patella of the 3rd and 4th legs.

Measurements in mm.:—Total length 6·5; mandible about 9; palp 13; 1st leg 19, 2nd 29, 3rd 18, 4th 29 (approx.).

Loc. Natal (*H. A. Spencer*).

This species is evidently nearly related to *R. crassus* Loman (Zool. Jahrb. xi. Syst. p. 520, pl. 31. figs. 7–9) from the Cape Colony (*loc.* ?), but apparently differs in the much smaller number of spicules in front of the ocular tubercle, the disposition of the spines on the ocular tubercle, the anterior and posterior rising at the same level and both on a level with the eye, and the absence of an angular projection on the base of the second segment of the mandibles.

PHALANGIUM (RHAMPSINITUS) TELIFRONS, sp. n. (Text-fig. 79, B.)

♂. *Colour* yellowish brown, finely mottled with darker median dorsal band.

Dorsal integument closely granular; abdomen with transverse segmental series of sharp tubercles. *Ocular tubercle* longer than high, more than its own diameter from the anterior border of the carapace (text-fig. 79, B), armed with two rows of 5–6 conical tubercles, the largest on the summit subequal to the diameter of the eye; three denticles on the sides of the carapace between the ocular tubercle and the lateral impression, an oblique row external to them, frontal area furnished on each side with a cluster of about a dozen larger and smaller teeth; the middle of the anterior border with a longish, subcylindrical, horizontally directed spine.

Mandibles a little longer than the body; basal segment studded above with numerous sharp tubercles, smooth at the proximal and distal extremities; armed below, externally and internally, with a partially double series of about seventeen or more longer and shorter, mostly curved short spines, decreasing in length towards the distal end of the segment and more or less clustered together at its proximal end; second segment quite smooth except for a few small low tubercles on the upper inner angle, subcylindrical, a little wider at its widest than the second segment. *Palpi* simple, hairy; tarsus longer than femur, which is itself longer than

patella and tibia; a few low tubercles on the trochanter. Coxæ of 1st and 2nd *legs* with a few low tubercles; trochanters of 1st, 2nd, and 3rd legs with a few spines.

Measurements in mm.:—Total length 8; length of carapace (from anterior border to second groove behind tubercle) 2; basal segment of mandible 3·5, second segment 5, width of latter 1·6; length of palp 9.

Loc. Cape Colony: Jansenville (*Miss Leppan*).

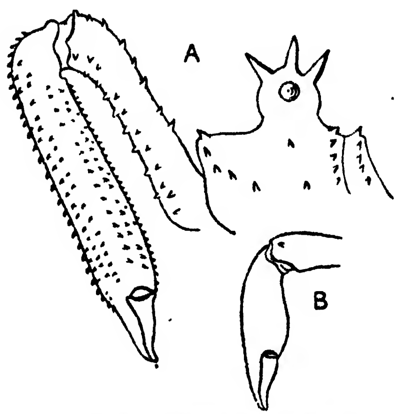
Differs from *R. spenceri* and *crassus*, to which it is nearly related, by the presence of a long porrect frontal spine, &c.

PHALANGIUM (RHAMPSINITUS) LEIGHI, sp. n. (Text-fig. 80.)

♂. *Colour* uniformly blackish brown throughout.

Dorsal integument finely and closely granular; carapace (text-fig. 80, A) with an oblique row of small tubercles on its lateral slope, a few marginal and a small one in the middle of the anterior border. *Ocular tubercle* about $1\frac{1}{2}$ times its diameter from the anterior border, very high, surmounted by *three* long subequal, subequally spaced spines, the anterior and the posterior rising at nearly the same level and above the centre of the eye. Dorsal scute of *abdomen* with segmental rows of sharp tubercles. *Mandibles* (text-fig. 80, A) long, but variable in length, and

Text-fig. 80.



Phalangium (Rhampsinitus) leighi, ♂ ♀.
A. Carapace and mandible of male. B. Mandible of female.

slender, like those of *Macropsalis*, studded with spicules, which are larger, more numerous, and closer-set on the 2nd than on the 1st segment. *Palpi* unarmed, shortly hairy, femur subequal to the patella + tibia; tarsus rather longer. *Legs* with spicular femora.

♀. A little larger than ♂, yellowish white below. Mandibles quite small and smooth, except for a few apical tubercles on the basal segment (text-fig. 80, B).

Measurements in mm.:—(♂ type). Total length 6; length of carapace 2·3; basal segment of mandible 4, second segment 6; palp about 8; femur of 1st leg 10, of 2nd 16, of 4th 12·5.

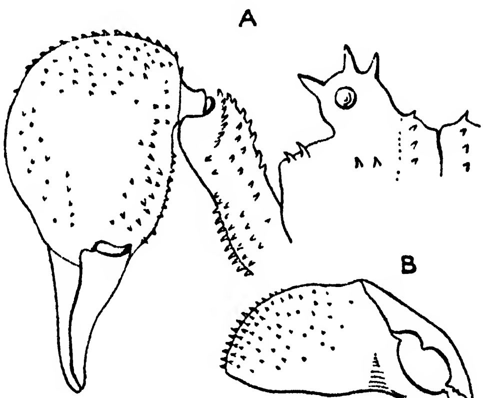
Loc. Durban (*G. F. Leigh*).

Resembling *R. minor* Loman, from Lower Illovo, Natal, in the presence of three pairs of spines on the ocular tubercle, but differing entirely in its much longer and strongly spicular mandibles.

PHALANGIUM (GURUIA) PALMATIMANUS, sp. n. (Text-fig. 81.)

♂. *Colour* of trunk blackish brown in the middle, pale at the sides; mandibles infuscate; palpi and legs yellowish, partially infuscate; trunk finely granular and segmentally spicular as in *P.* (*R.*) *spenceri*. *Ocular tubercle* higher, armed with three long spines on each side; only two or three small spicules on the anteocular area, no prominent one in the middle, one spicule external to the tubercle, three beyond it and some at the margin.

Text-fig. 81.



Phalangium (*Guruia*) *palmatimanus*, ♂.

A. Carapace and mandible of male. B. Anterior view of mandible of the same.

Mandibles (text-fig. 81, A & B) with basal segment subcylindrical, tubercularly spinous above, externally and below, the tubercles thicker and smaller below; second segment very large, subglobose, spicular, except internally; fingers long, widely separated, each with two large teeth and some smaller near the apex. *Palpi* with trochanter directed transversely, spicular; femur arcuate, with convexity external, spicular at apex above; patella tubercular above, with one external distal spicule, and an internal distal rounded projection, covered with short hairs; tibia a little longer than patella, tarsus longer than the sum of the two, with a small claw. *Legs* with coxæ, femora, and patellæ spicular;

tibia and protarsus of 1st also spicular, of 2nd, 3rd, and 4th scarcely so; tarsi of 3rd and 4th scopulate below, of 1st and 2nd less so.

Measurements in mm.:—Total length 6; mandible 9; palp 10; 1st leg 23, 2nd 43, 3rd 25, 4th 36.

Loc. East Africa: Mombasa (*D. J. Wilson*).

This species appears to fall into the genus *Guruia* of Loman (Zool. Jahrb. xvi. pt. 2, p. 172, 1902), judging by the form of the mandible, and the presence of three ocular spines. But the ocular tubercle is only separated from the anterior border of the carapace (text fig. 81, A) by a space equalling its own long diameter. It further differs from *G. frigescens* from Gurui in the larger size of the ocular spines, its longer legs, and in having the tarsus of the palp longer than the femur. It is also longer-legged than *G. levis* from Zanzibar, and further differs in the form of the mandible.

To distinguish *Guruia* from *Rhampsinitus*, Loman gives:—Legs shorter; palpi very slender, much weaker than the legs, partly concealed by the large mandibles; mandibles of male much longer than the body, with the second segment thickened and oval; ocular tubercle in the posterior part of the carapace, a little longer than high, armed above with three dissimilar denticles.

In *P.* (*G.*) *palmatimanus* the legs are much longer than in *P.* (*R.*) *spenceri*, and the palpi relatively shorter and slightly more robust. In neither are they partly concealed by the mandibles. In both the posterior slope of the tubercle rises on a level with the groove lying just in front of the first transverse row of tubercles on the carapace; and the frontal area of the carapace is relatively a little longer in *P.* (*R.*) *spenceri* than in *P.* (*G.*) *palmatimanus*, and the ocular tubercle is lower. The relative length of the mandibles in the two is about the same.

Genus Macropsalis Sörens.

Macropsalis hoggi, sp. n.

♀. *Colour* yellowish brown, marbled with darker richer brown and spotted with white; palpi and mandibles pale, clouded with brown; legs pale, distinctly banded with brown.

Carapace with numerous scattered denticles before, behind, and beside the tubercle, a few more externally; tubercle with at least two rows of spicules.

Mandibles densely covered with spicules; fingers not crossing when closed. *Palpi* with patella shorter than tibia and without process. Trochanters of *legs* spinous in front; femora spinous, especially the anterior above and beneath; patellæ of 1st, 3rd, and 4th spinous above and below, especially that of 1st leg, of 2nd with two apical spicules above; tibia of 1st thickly spinous, of the rest smooth, that of the 2nd with spurious articulations.

♂. Differs from ♀ in having the second segment of the mandible much more sparsely and strongly denticulated in front, and the distal extremity of the patella of the palpus produced

into a process which is about one-fourth the length of the segment; 4th leg smooth.

Measurements in mm.:—♀. Length of carapace 2; of basal segment of mandible 6, second segment 7.

Loc. Macedon, in Victoria (*H. R. Hogg*).

The male specimen, which is unfortunately somewhat damaged, differs from that of the type of *M. serritarsus* (Sörensen) in the smaller size of the patellar apophysis of the palp.

Genus PANTOPSALIS Sim.

PANTOPSALIS ALBIPALPIS, sp. n.

♂. *Colour* a tolerably uniform brown; palpi pale yellowish white.

Carapace with a few small spicules in front of the tubercle, and a few on the posterior slope of the latter.

Mandibles twice as long as the carapace, slender except for the club-like expansion of the distal end of the 2nd segment; spicular and tubercular all over. *Palpi* unarmed, patella and tibia subequal. *Legs* with trochanters unarmed; femora sparsely and weakly spicular, remaining segments unarmed except for some terminal spicules above on the patellæ.

Measurements in mm.:—Length of carapace 2·5; length of basal segment of mandible 11·5, distal segment 13.

Loc. New Zealand: Maungatua, S. of Dunedin (*J. V. Jennings*).

Whether or not this species is based on the male of *P. listeri* White (P. Z. S. 1849, p. 6, and Simon, CR. Soc. Ent. Belg. xxii. p. lxxiii, 1879) from the Middle Island, New Zealand, I am unable to say. The British Museum has two examples that I refer to *P. listeri* White, ticketed New Zealand ('Samarang'), and Greymouth, N. Zealand. In both, as in *P. albipalpis*, the palpi are pale as described by Simon, and the mandibles are much shorter and thicker than in the type of *P. albipalpis*. I infer that these examples are females on account of the resemblance in the structure of the mandible that they present to the female specimen referred to below as the female of *P. nigripalpis*.

PANTOPSALIS NIGRIPALPIS, sp. n. (Typical form.)

♂. Colour deep blackish brown; palpi as dark as the legs. Further differing from the preceding species in having the terminal portion of the second segment of the mandibles much less clavate, and the tubercles on the mandibles fewer and sharper.

Measurements in mm.:—Length of carapace 2; 1st segment of mandible 9, 2nd 10.

Loc. New Zealand: Dunedin (*G. M. Thomson*).

Subspecies SPICULOSA, nov.

♂. Coloured like the typical *P. nigripalpis*, from which it

differs, as also it does from *P. albipalpis*, in having the ocular tubercle and the area of the carapace in front of and at the sides of it much more thickly and strongly denticulated.

Measurements in mm.:—Length of carapace 2; of 1st segment of mandible 10, of 2nd 11.

Loc. New Zealand: West Taieri Bush, Otago (*J. V. Jennings*). One male example without its legs.

There is also in the British Museum a female example with the mandibles much shorter and thicker than in the above described males, which may represent the female sex of either of the forms of *P. nigripalpis*. It was collected in Maungatua by Mr. J. V. Jennings.

Suborder MECOSTETHI.

Group INSIDIATORES.

Family TRIÆNOBUNIDÆ.

Genus TRIÆNOBUNUS Sörens.

TRIÆNOBUNUS PECTINATUS, sp. n. (Text-fig. 84, C, p. 410.)

Colour blackish; legs variegated with yellow.

Dorsal scute depressed, ornamented with a network of granular ridges separated by smooth interspaces and showing a segmental arrangement behind the cephalic constriction, forming four transverse rows which pass between the five rows of tubercles; of these tubercles the median are the largest and recurved (text-fig. 84, C). *Ocular tubercle* directed upwards and forwards, long, spiniform, armed above with smaller procurved spiniform tubercles, below with one, and on each side with three long spines, the first close to its base, the third with its fellow giving a tridentate appearance to the tubercle; on each side of the tubercle there are five long strong spines. The first and second free *tergites* granular and armed, like the posterior border of the scute, with seven strong spines, one being median; the third tergite less regularly, but not less strongly spined; the fourth (anal) tubercular. *Sterna* with a transverse series of tubercles.

Mandibles weakly tubercular. *Palpi* shortish, not very strong, shorter than the dorsal scute; the femur with some hair-tipped tubercles above and three long spines below; tibia with two, tarsus with three pairs of interior spines.

Legs with coarsely granular coxæ, that of 1st shortly spined in front, of 2nd and 4th strongly spined above externally; trochanters and femora also spined, especially the femur of the 1st, which is armed with long, stout, close-set spines, those on the dorsal side forming a series, ten in number; patellæ and tibiæ tubercular, tubercles on the 1st leg more spiniform than those on the others; constricted portion of protarsus subconical; tarsal segments of 1st 3, of 2nd 6, of 3rd and 4th 4; ultimate segment of 3rd and 4th tarsus longer than the antepenultimate (second),

Measurements in mm.:—Total length 5; palpi 2·5; 1st leg 5, 2nd 9, 3rd 6, 4th 9.

Loc. Tasmania. A single specimen received from Mr. G. W. Peckham.

Certainly differing from *T. bicarinatus* Sörens. (Arachn. Austral., Opiliones, 1886, p. 60), from Sydney, in the strong spine-armature of the legs of the 1st pair. Sörensen, moreover, gives the tarsal segments as 3, 5, 3, 3.

Family ADÆIDÆ.

Genus ADÆUM Karsch.

Karsch, Zeits. ges. Naturw. liii. p. 403 (1880); Loman, Zool. Jahrb. xi. Syst. p. 525 (1898).

ADÆUM AREOLATUM, sp. n.

♂. *Colour* yellowish brown, generally obscured by the mud or mould adhering to the granules. *Dorsal scute* with anterior border convexly rounded and thickly beset with cylindrical papillæ; ocular tubercle thickly granular, convexly rounded on the summit; behind the tubercle are two parallel rows of tubercles extending to the posterior border of the scute and forming segmental excrescences; midway between these and the lateral border is another irregular band of granules extending from the antero-lateral angle; there are also narrow transverse rows of granules extending across the scute from side to side and passing between the submedian granular excrescences; the interspaces between and defined by the bands of granules form subquadrate smooth depressed areas. The posterior border of the scute and of the three following tergites with a row of papilliform tubercles; the rest of the tergal plates thickly granular. *Sterna* granular anteriorly. *Coxæ* thickly granularly papillate. *Genital sternum* with seven long hair-tipped papillæ. *Sternum* of *cephalothorax*, the adjacent area of the 3rd coxa and the maxillary process of the 2nd coxa forming a smooth and shining depression flanked on each side by the papillæ arising from the coxæ.

Mandibles with basal segment granularly tubercular above, with one or two longer papillæ distally; second also with some sharp tubercles in front. *Palpi* thicker than the legs, thickly granular; the femur at the base on the inner side with four strong spines and one more distal, and beneath with one smaller and three strong spines, and one strong spine on the inner side inferiorly; tibia, patella, and tarsus subequal in length; the tibia without distinct and large paired spines beneath; tarsus with three pairs of longer spines in addition to the tubercles; claw short.

Legs tubercular and granular, unspined, even the femur of the 1st hardly spined below; some longish cylindrical papillæ on the outer side of the 2nd and 4th coxæ; tarsal segments 4, 11, 4, 4.

♀. Differs from ♂ in that the papillæ on the anterior border of the carapace are shorter and form a median angular projection;

the spines on the base of the inner side of the femur of the palp are much smaller, and the tibia is armed internally with longer hair-tipped papillæ.

Measurements in mm.:—(♂) Total length 7·5; palpus 5; 1st leg 8, 2nd 13, 3rd 9, 4th 12.

Loc. Grahamstown in S. Africa (*Dr. Schönland*).

This species at least differs from *A. obtectum* and *A. lutens* Loman, from Knysna, in having the ocular tubercle rounded on the summit instead of angularly acuminate, and also in the armature, at least of the femur of the palp, and apparently of the first leg, since Loman gives the presence of spines beneath the femur of this appendage as a generic feature. With *A. asperatum* Karsch, which was probably from Port Elizabeth, where Mr. I. L. Drège resides, it is not possible to make any comparison.

Genus Larifuga Loman.

Phalangium rugosum Guér. (Icon. Reg. Anim. iii. Arachn. p. 12, pl. iv. fig. 4 (nec 4 *a*–4 *b*), 1829-1843[1]; also Gervais, Ins. Apt. iii. p. 128, 1844), the type of which was in Keyserling's Collection and is now preserved in the British Museum, belongs to the genus *Larifuga* Loman, but seems to approach rather nearer the genus *Adæum* than does the typical species *L. weberi*, since the sternum is apparently less sharply angular and therefore not so markedly pentagonal in shape. It further differs in that the ocular tubercle is not apically acuminate, but bears 4–5 tubercles on the summit; the dorsal scute is granular, with smooth transverse segmental areas separated by bands of granules arranged in 2-3 rows, each of the segments being marked by at least one pair of small submedian tubercles, those of the last being in line with a transverse row of coarse tubercles, while those of the first are almost lost amid the granules that lie behind the ocular tubercle—the tubercles, in fact, are practically the same in number and position as in *L. weberi*; anteriorly the carapace has one median porrect tooth and five large subvertical teeth above the anterior border. The three anterior free terga have a row of coarse tubercles, the first of them having as well a row of granules; the anal tergite has smaller, more scattered tubercles; there is a transverse row of granules on the sterna. Coxæ beset with scattered granules. The basal segment of the mandible with a distal row of fine tubercular teeth, the external the smallest. Trochanter of palp with three strong spines below; femur with about five, the two basal the largest but unequal.

[1] In Guérin's original description, reference is made to pl. iv. fig. 4 *b*, which purports to represent the ventral surface of the specimen numbered 4. It is evident, however, that this drawing of the ventral surface is taken from some species of Phalangiidæ and not from the specimen shown in fig. 4. This is clearly proved by the difference in the size of the palpi of the two. Fig. 4 *b* probably represents the underside of the European Phalangium, the ocular tubercle of which is shown by fig. 4 *a*.

Family Triænonychidæ.

The principal characters of the genera of this family in its restricted sense may be tabulated as follows:—

a. Ocular tubercle very high . . . . *Acumontia.*
b. Ocular tubercle low.
  a[1]. Ocular tubercle upon or close to the anterior margin of the carapace.
    a[2]. Anterior area of dorsal scute shorter than the rest of its components taken together . . . . [*Nuncia.* *Triænonyx* &
    b[2]. Anterior area of dorsal scute as long as the rest of its components taken together . . . . *Diasia.*
  b[1]. Ocular tubercle some distance behind the anterior border of the carapace.
    a[3]. Anteocular portion of carapace horizontal; palpi strongly spined; claw of 3rd (? of 4th) leg strongly branched . . . . *Sorensenella.*
    b[3]. Anteocular portion of carapace sloped downwards and forwards; palpi weakly spined; claws of 3rd and 4th legs weakly branched . . . . *Lomanella.*

Genus Triænonyx Sörens.

Triænonyx coriacea, sp. n. (Text-fig. 83, B & C, p. 408.)

♀. *Colour* deep brownish; legs yellow, clouded with black; mandibles and femur of palp black.

Dorsal surface (text-fig. 83, B & C) coriaceous, the segments of the carapace and abdomen each marked by an ill-defined series of low tubercles. *Ocular tubercle* conical, bluntly rounded, neither spinous, tubercular, nor granular. Abdominal *sterna* smooth.

Mandibles smooth above, basal segment a little longer than wide, with one apical tubercle above, second segment with a few granules. *Palpi* moderately robust, the trochanter with a pair of tubercles below; femur with a pair below the base and one near the distal end, about four, whereof two are spiniform, above and two or three internally; patella with one on the inner side beneath; tibia with three pairs of variously sized spines or tubercles; tarsus with two inner and three outer spines.

Coxa of 1st *leg* without spines or long tubercles, simply tubercular like that of the 2nd leg below; that of 3rd less tubercular, that of 4th nearly smooth below, some strong tubercles on the posterior side of the 2nd and anterior side of the 4th; groove between coxæ of 3rd and 4th tubercular; trochanters of 1st, 2nd, and 3rd weakly tubercular, femora of the same and tibia of 1st and 2nd also weakly tubercular; tarsus of 1st with three segments, of 2nd with eight, of 3rd and 4th with four; a pair of spines at the distal end of the protarsus of 1st, 3rd, and 4th; three distal segments of 3rd tarsus subequal in length, antepenultimate segment of 4th tarsus shorter than the sum of the two distal segments but longer than either.

♂. Differs from ♀ in having a strong cephalic constriction and the posterior portion of the body more elevated; the ocular tubercle triangular, more sharply pointed; the maxillary pro-

cesses of the second pair of legs longer and more pointed, and the spines on the palpi stronger.

Measurements in mm.:—(♀) Total length 5·5; palpus 4; 1st leg 7, 2nd 10, 3rd 6, 4th 10.

Loc. New Zealand: Auckland (*D. A. Steel*).

TRIÆNONYX ASPERA, sp. n.

Colour (dry) paler than *T. coriacea.* Shape of *body* much like that of the female of that species, the dorsal surface somewhat sparsely but coarsely granular. *Ocular tubercle* low, granular; free tergites with a row of subequal tubercles and some granules as well.

Mandibles with spine on basal segment, and spiniform tubercles on second segment.

Palpi much stronger and more strongly spined than in *T. coriacea*; femur convex above, and armed with about four spines and some tubercles, some tubercles externally, three long spines beneath externally and one smaller internally, two on the inner side distally; patella with one or two tubercles, and one internal and one external spine; tibia about one-fourth or one-third longer than the patella, smoother, armed with three pairs of strong spines and a smaller proximal one on the outer side; tarsus with four pairs of spines. *Legs* longer, femur of 1st armed above and below with strong tuberculiform spines, a few on the tibia also; tarsal segments 3, 13, 4, 4; the distal portion of the protarsus constricted to form a short spherical or nodular piece, quite different from the elongate subconical piece of *T. coriacea.*

Measurements in mm.:—Total length 5; of palpus 5; 1st leg 8, 3rd 7·5, 4th 12.

Loc. Australia.

TRIÆNONYX SUBLÆVIS, sp. n. (Text-fig. 84, D, p. 410.)

Colour brownish; legs variegated with yellow.

Shape of *body* in profile intermediate between the male and female of *T. coriacea*, but the ocular eminence not so far forward, its anterior surface sloping backwards and upwards from a little behind the anterior edge of the carapace. *Dorsal scute* and *tergites* almost smooth, minutely coriaceous but with scarcely a trace of segmental tubercles or granules; no tubercles near the fore part of the cephalic area, merely the normal median spines. *Sterna* with the transverse row of tubercles nearly obsolete.

Mandibles with basal segment very long, subcylindrical, at least four times as long as broad, with a small posterior dorsal distal tubercle; second segment with a series of tubercles ending in one longer spine in front.

Palpi long and powerful; trochanter with a few short spines above and one long spine below; femur convex above, armed above and internally with dentiform tubercles, one on the inner side being spiniform, beneath with one long basal spine and some smaller spines or tubercles; patella with one inner spine; tibia

one-third longer than patella, with three long internal and two long external spines in addition to some smaller ones between and beyond the latter; tarsus with three internal and three external spines, the proximal external small; claw longish and slightly curved. *Coxa* of palp and of 1st leg bispinate in front; coxa of 1st and 2nd legs tubercular, the latter externally spinate; remaining coxæ nearly smooth, some tubercles on the posterior border of 3rd and 4th. Maxillary process of 2nd leg (text-fig. 84, D) double, consisting of a large quadrate tubercular process in addition to the normal process. Remaining segments of legs not spined, femora of 1st and 2nd at most tubercular; tarsal segments 3, 10 or 11, 4, 4; distal extremity of protarsi elongate, subconical.

Measurements in mm.:—Total length 6; palp 8; 1st leg 10, 4th 14.

Loc. West Taieri Bush, Otago, New Zealand (*J. V. Jennings*).

In a young specimen of this species (3·5 mm. long) the tarsus of the 1st leg is bisegmented, that of the 2nd bisegmented with merely indications of subsegmentation, those of the 3rd and 4th trisegmented, the distal segment of the 4th showing faint signs of subdivision; the sternum is more like that of *Adæum* in shape.

The known species of the genus from the Australian Region may be tabulated as follows:—

a. Dorsal scute furnished posteriorly with transversely and metamerically disposed series of granules and with one pair of spiniform tubercles ... *rapax.*
b. Dorsal scute without metamerically disposed rows of granules and no paired spiniform tubercles.
  a[1]. Dorsal scute granular or coarsely coriaceous.
    a[2]. Dorsal scute coriaceous; distal portion of protarsal segment of legs elongate, pyramidal ... *coriacea.*
    b[2]. Dorsal scute coarsely and sparsely granular; distal portion of protarsus spherical and nodular ... *aspera.*
  b[1]. Dorsal scute neither granular nor coarsely coriaceous ... *sublævis.*

The species from Stephen's Isl., New Zealand, recently described by Loman (Zool. Jahrb., Syst. xvi. 1902, p. 214) as *Nuncia sperata*, is said to differ generically from *Triænonyx* in having the ocular tubercle large, convex and unarmed.

Genus Acumontia Loman.

Zool. Jahrb., Syst. xi. p. 528 (1898).

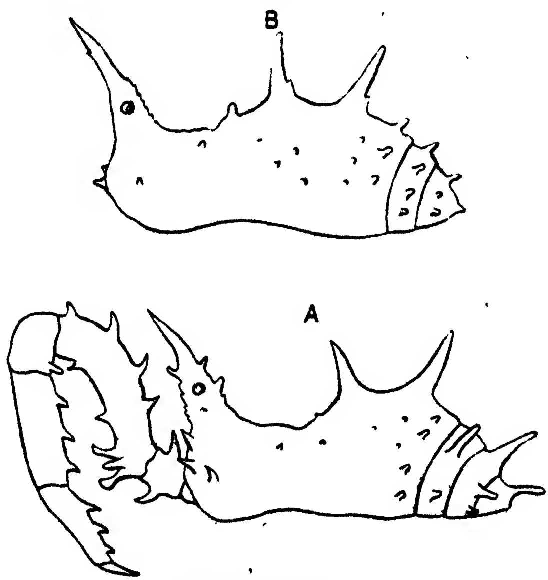
Acumontia rostrata, sp. n. (Text-fig. 82, p. 406.)

♂. *Colour* a uniform blackish brown.

Dorsal scute with lightly sinuous sides, granular, elevated posteriorly; armed in front on each side with three suberect spines in addition to the three, one median and one on either side, which project forwards between and externally to the mandibles (text-fig. 82, A). *Ocular tubercle* very high, armed with a few

tubercular spines and surmounted by a long pointed smooth process; the eye about the middle of the tubercular portion. The posterior elevated area armed with two pairs of long, suberect, divergent spines; a few scattered tubercles elsewhere, and a row of tubercles, of which one towards the lateral margin is larger, along the posterior border. First free *tergite* with one long spine midway between the middle and the lateral border, and one short submarginal spine; second with two shortish submarginal spines and one long submedian spine on each side; third with one long submedian spine on each side; for the rest the plates show a row of tubercles; anal tergite with a pair of subcentral, larger tubercles, a posterior median cluster, and some marginal tubercles. *Sterna* with a row of tubercles each.

Text-fig. 82.



Acumontia rostrata, ♂ ♀.

A. Lateral view of dorsal surface and palpus of male.
B. „ „ „ „ of female.

Mandibles large, as thick as the palpi; basal segment with one superior spine, second segment with about half a dozen tubercular spines of varying size.

Palpi (text-fig. 82, A) very long and strong; trochanter with one large upper and under spine, a smaller external spine as well; femur arcuate, armed below with five spines, three of which are proximal, above with a series of four and one more internal, and internally with two; patella with one infero-external and two

internal tubercular spines; tibia and tarsus with three pairs of long and strong spines.

Legs with coxæ tubercular, that of the 1st with about three strong blunt spines; coxæ of 2nd and 4th pairs tubercular above; trochanter tubercularly spinous, that of the 4th with two longish superior spines; femur of 1st with three spines in its proximal half below, of the 3rd with spinous tubercles posteriorly. Tarsal segments of 1st leg 5, of 2nd 13–15, of 3rd and 4th 4.

♀. Smaller and more thickly granular; ocular tubercle less tubercular; dorsal scute without the anterior three pairs of spines, the long spines shorter than in the male and preceded by a pair of low tubercular spines; no long spines on the free tergites, but the tubercles all longer and more spiniform than in the male (text-fig. 82, B). *Palpi* shorter, but otherwise similar to those of male. Distal protarsal segment of 1*st leg* thickened but strongly excavated below.

Measurements in mm.:—♂. Total length of body 7; of palp about 12; 1st leg about 15, of 2nd about 25, of 3rd 27, of 4th 24.

Loc. Madagascar: Ambohimitombo, in the Tanala district (*C. I. Forsyth Major*, type ♂); also Betsileo (*Deans Cowan*).

The specimens from Betsileo are three in number, an adult and two subadult females, the latter differing from the former in the absence of the emargination at the extremity of the protarsus of the 1st leg. They are distinguished from the typical examples from Ambohimitombo by the shortness of the dorsal spines and tubercles, which are only about half as long as those of the female of the typical form of *A. rostrata*. I propose therefore to regard the Betsileo form as a subspecies which may be called *A. rostrata* subsp. *cowani* nov.

A. rostrata certainly differs from *A. armata* Loman in the spine-armature of the dorsal surface, the dissimilarity between the sexes with regard to spine-armature, &c.

It is noticeable that Loman makes no mention of the modification of the distal end of the protarsus of the 1st leg in either of the sexes of *A. armata*.

Judging, too, by the measurements given of the appendages, *A. armata* is a much shorter-legged form than either of the species here described. The following are the leg-lengths in millim. of *A. armata*:—1st leg 7·5, 2nd 11, 3rd 8·5, 4th 12.

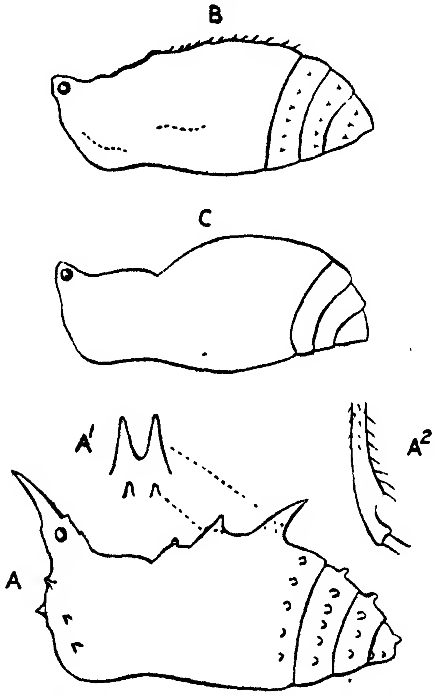
ACUMONTIA MAJORI, sp. n. (Text-fig. 83, A, p. 408.)

♂? *Colour* more ruddy brown than the foregoing.

Dorsal scute sparsely granular; ocular tubercle as high as in *A. rostrata*, but thicker at the base and less tubercular than in the male of that species; a pair of small spines on each side of the carapace near its fore border, in addition to the three projecting between and outside the mandibles; posterior area less elevated than in *A. rostrata*, and armed with two pairs of spines, the posterior long, the anterior short, directed obliquely

upwards and backwards, parallel, not diverging from each other (text-fig. 83, A, A¹). A row of tubercles in front of the posterior border of the scute and of the free tergites; a submedian pair on the 2nd and 3rd of the latter larger than the rest. *Sterna* with a series of small tubercles.

Text-fig. 83.



Acumontia majori, ♀?, and *Triænonyx coriacea*, ♀.

A. Lateral view of dorsal surface; A¹. Spines of the scute from above; and A². Extremity of protarsus of 1st leg of female *Acumontia majori*. B. Lateral view of dorsal surface of female; and C. Lateral view of dorsal scute of male *Triænonyx coriacea*.

Mandibles with basal segment longer than in *A. rostrata*; second segment with a few antero-interior spiniform tubercles. *Palpi* similar to those of *A. rostrata*, but shorter; spines much the same except that the external spines on the tibia are short, tubercular, and much shorter than the internal which are very strong; tibia granular below; tarsus with four pairs of spines, the apical small.

Coxa of 1st *leg* strongly spined, of 2nd tubercular internally, of 3rd with one tubercle near the middle line, of 2nd and 4th

spinous above; trochanters not spiny; femur of 1st with some weak inferior spines, of the rest not spiny. Tarsus of 1st with 5, of 2nd with 12, of 3rd and 4th with 4 segments.

♀ (?). With three small tubercular spines on each side of the head-shield in front. Palpi a little larger, no spine on the dorsal side of the trochanter; femur with three strong dorsal spines, the distal one represented in the other sex obsolete, and one strong median internal spine. Distal end of protarsus of 1st leg incrassate, with the inferior distal half of the thickened area strongly emarginate.

Size about the same as that of *A. rostrata*.

Loc. Madagascar; Ambohimitombo (*C. I. Forsyth Major*).

The specimen I have described as the male of this species is probably not quite adult. It is smaller than the other, and in the spine-armature of the palpi much more nearly resembles both sexes of *A. rostrata*. The other specimen I regard as the adult female, on account of the peculiar modification of the extremity of the protarsus of the 1st leg (text-fig. 83, A^2), which also obtains in the specimen considered to be the female of *A. rostrata*.

The following is a key to the known species of *Acumontia*:—

Males.

a. Free abdominal tergites furnished with a few very long spines . . . *rostrata*.
b. Free abdominal tergites furnished with tubercles or short tuberculiform spines.
  *a*¹. Antero-lateral tubercles on the carapace very small, the posterior pair of spines on the dorsal scute close together, contiguous basally . . . *majori*.
  *b*¹. Antero-lateral tubercles large; posterior dorsal spines shorter and widely separated basally . . . *armata*.

Females.

a. Two pairs of long subequal spines on posterior portion of dorsal scute; antero-lateral spines absent . . . *rostrata*.
b. Posterior two pairs of spines unequal, the anterior short.
  *a*¹. Posterior spines basally contiguous . . . *majori*.
  *b*¹. Posterior spines basally widely separated . . . *armata*.

Genus SORENSENELLA, nov.

Distinguishable from *Triænonyx*, &c. by the situation of the ocular tubercle in the centre of the cephalic scute and behind its anterior margin. Lateral branches of claws of 3rd (probably also of 4th) leg considerably longer than the median branch—hence the tarsus appears to be *three-clawed*.

Type, *S. prehensor*.

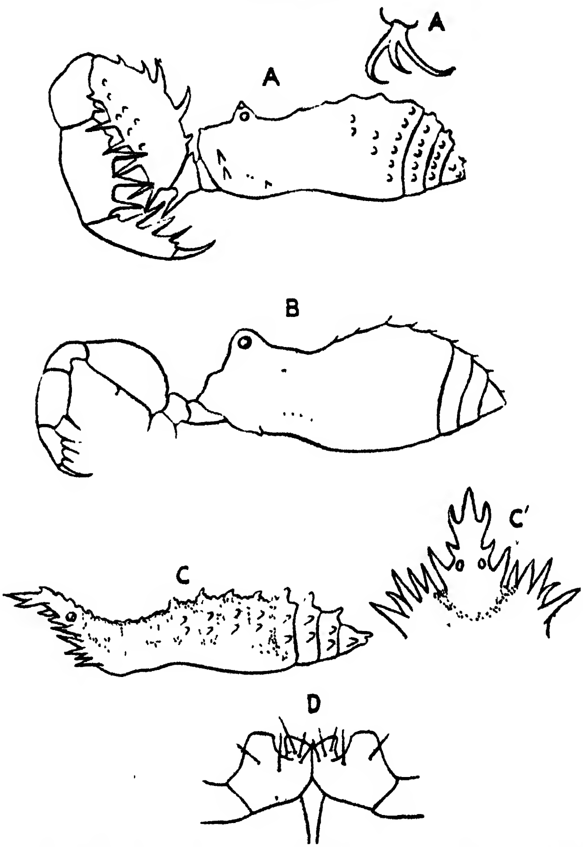
SORENSENELLA PREHENSOR, sp. n. (Text-fig. 84, A, p. 410.)

Colour uniformly brownish.

Dorsal surface (text-fig. 84, A) tolerably smooth; anterior border of cephalic scute mesially tridentate; three lateral spines on each side, the inner the largest, the posterior lying far back

above the basal articulation of the third leg; ocular eminence low, transverse, with a dentiform tubercle on its summit. Behind the ocular eminence the median and to a less extent the lateral area of the dorsal scute is segmentally tubercular, a

Text-fig. 84.



Sorensenella prehensor, *Lomanella raniceps*, *Trianobunus pectinatus*, and *Trianonyx sublævis*.

A. Lateral view of dorsal scute and palpus; and A'. Claw of 3rd leg of *Sorensenella prehensor*. B. Lateral view of dorsal surface and palpus of *Lomanella raniceps*. C. Lateral view of dorsal surface; and C'. Anterior end of carapace, from above, of *Trianobunus pectinatus*. D. Maxillary lobes of 2nd pair of legs of *Trianonyx sublævis*.

row of tubercles running before its posterior border and before that of the two following free tergites. *Sterna* nearly smooth, with a nearly obsolete row of tubercles.

Mandibles (largely hidden from view) with a small tubercle on the basal segment, a much larger one on the proximal end of the second.

Palpi (text-fig. 84, A) very powerful; trochanter with short superior and a long inferior spine; femur robust, convex dorsally, and armed with four or five spines, externally furnished with a few tubercles, armed below externally with six long spines, its inner surface with about six longer and shorter spines; patella strongly constricted, with one short external and two long internal spines; tibia longer than patella, armed externally with three long spines and a basal tubercular spine, internally with four spines, the distal short; tarsus long, armed with three pairs of long spines, a pair of distal, and one proximal external tubercular spine.

Coxæ of *legs* granular; of 1st spined in front, of 2nd and 4th with one external spine; the rest of the segments unspined, nearly smooth; femur of 1st weakly tubercular below. Tarsal segments 3, 10, 4 (fractured on 4th leg); first and second segments of first tarsus subequal, the sum of them rather longer than the first or proximal segment; on the third tarsus the first segment as long as the sum of the other three, the second and fourth subequal, and either of them longer than the second.

Measurements in mm.: - Total length 3·5; palp about 6; of 4th leg 8·5.

Loc. New Zealand (*Dr. Richardson*).

There is in the British Museum a second well-marked species of this genus represented by a damaged specimen without indication of locality, which, for these reasons, I refrain from naming.

Genus Lomanella, nov.

Distinguished from the hitherto described genera of Triænonychidæ, with the exception of *Sorensenella*, by the position of the ocular tubercle some distance behind the anterior border of the dorsal scute; the area in front of the tubercle, however, falls obliquely downwards and forwards. Spiracles conspicuous, on a level with the middle of the distal half of the 4th coxa, which is not enlarged. Palpi weakly spined.

Type, *L. raniceps.*

Lomanella raniceps, sp. n. (Text-fig. 84, B.)

Colour blackish, dorsal surface (text-fig. 84, B) ornamented mesially with transverse yellow stripes, a large yellow patch above the bases of the 3rd and 4th legs; legs and palpi variegated yellow and black; sterna longitudinally banded black and yellow.

Dorsal surface closely, finely, and evenly granular all over, the fused and free terga indicated by transverse series of coarser granules; anterior border of scute evenly convex, with a process arising above the base of the 2nd leg, concave above the 3rd and 4th legs, then evenly convex to the middle line posteriorly.

Mandibles small, basal segment unarmed above, its distal end

forming a low rounded elevation; second segment scarcely tubercular.

Palpi (text-fig. 84, B) long and robust; femur strongly convex above, with a setiferous tubercle at the base below, and a smaller one near the middle of the inner surface; patella without tubercles; tibia convex below, one-third longer than the patella, armed beneath beyond the middle with a pair of setiferous tubercles; tarsus armed with three pairs of setiferous tubercles, the distal the smallest.

Coxæ of *legs* granular like the dorsal surface, some larger granules on the posterior border of the 2nd, 3rd, and 4th legs; rest of the leg-segments without spines; femur of 1st tubercular beneath. Tarsal segments 3, 5, 4, 4; those of the 1st leg subequal, the second segment only slightly shorter; of 3rd leg the first tarsal is about as long as the second and third, the third and fourth being subequal and slightly shorter than the second; much the same proportion of segments prevails on the tarsus of the 4th leg.

Measurements in mm.:—Total length 2·5; palp 3; 2nd leg 7, 4th 6.

Loc. Tasmania. Specimen received from Mr. G. W. Peckham.

Group Laniatores.

Family Hinzuanidæ.

Genus Hinzuanus (Karsch) Loman.

Hinzuanus leighi, sp. n.

Colour of trunk and legs yellow, thickly clouded with black, the mandibles mostly yellow; femur and patella of palp yellow, distal segments infuscate, a pale ring round the femora and tibiæ of the legs.

Trunk thickly granular above and below; no spiniform processes on the fore border of the carapace. *Eyes* large, distance between them much greater than that between either and the fore border of the carapace. A deep groove behind the carapace; abdomen elevated, convex, its third and fourth segments with a pair of sharp submedian tubercular spines; a row of large tubercles along the posterior border of the dorsal scute and of the following three tergal plates; the anterior four tergites subequal in length. Femur of *palp* with a setiferous tubercle beneath; patella with apical spine, tibia and tarsus with two pairs of spines. Tarsus of 1st *leg* with three, of 2nd to 4th with five tarsal segments.

Measurements in mm.:—Total length 4; width 2; height 2; 1st leg 7, 2nd 11, 3rd 8·5, 4th 12·5.

Loc. S. Africa: Natal (*G. F. Leigh*).

Distinguishable by the presence of the spiniform tubercles on the third and fourth tergites, a character suggestive of what occurs in the genus *Lacurbs*. Since *Hinzuanus*, according

to Loman, supersedes *Biantes*, the family name should be Hinzuanidæ.

Family Oncopodidæ.

Genus Pelitnus, Thor.

Pelitnus pulvillatus, sp. n.

Colour a tolerably rich reddish brown, the dorsal side of the body sometimes infuscate and contrasting with the paler appendages, the latter very indistinctly banded.

Differs from *P. annulipes* Poc. in the following particulars:—*Body* wider, the abdominal portion being almost as wide as long; its upper side more convex longitudinally, the first free tergite rising somewhat abruptly higher than the dorsal surface of the carapace, the third tergite the highest point of the body, excluding the ocular tubercle. Ocular tubercle erect, slender apically, separated from the posterior sulcus of the carapace by a space which at least equals its own basal diameter, its anterior border vertical. The 1st, 2nd, 3rd, 4th, and 5th sterna with their posterior half covered, except laterally, with a thick carpet of short, close-set hairs.

Palpus with its femur dorsally more tumid and more convex on the inner side; spine on lower side of trochanter of palp smaller than that on the femur, which is large and triangular; all the segments of the legs and palpi relatively shorter and stouter.

Measurements in mm.:—Total length 6; width 4·2; of 1st leg 8, 2nd 12, 3rd 9, 4th 13.

Loc. Malay Peninsula: Selangore. "In cave" (*H. N. Ridley*).

Pelitnus piliger, sp. n.

Nearly allied to *P. pulvillatus*, but with the upper side of the trunk blackish and contrasting strongly with the paler appendages, the mandibles and palpi being clear reddish yellow, without trace of infuscation; femora and tibiæ of the legs infuscate. Body and appendages of the same relative size and form as in *P. pulvillatus*, but the postocular area of the carapace sloping upwards from the groove to the tubercle not horizontal, the tubercle itself wider than high, with a bluntly rounded summit. Spine on trochanter of *palp* longer, cylindrical, smaller than that of the femur, which is also cylindrical and curved forwards.

Measurements in mm.:—Total length 6; width 4·2; 1st leg 8, 2nd 12, 3rd 9, 4th 13[1].

Loc. Malay Peninsula: Bukit Besar, 2500 feet alt. "Under bark of fallen tree" (*Annandale* and *Robinson*).

These two species differ from the previously described members of the genus in the presence of the transverse bands of coarse pubescence upon the abdominal sterna.

[1] In this and other cases the measurements of the legs do not include the coxæ.

7. On the Australasian Spiders of the Subfamily *Sparassinæ*. By H. R. Hogg, M.A., F.Z.S.

[Received November 4, 1902.]

(Text-figures 85–104.)

The members of this subfamily are abundant in all tropical and subtropical countries. Their large size and hairy appearance enable them to inspire a sentiment of fear out of all proportion to their really timid nature and defenceless character. This has no doubt acted as a means of protection to them.

Living originally about the trunks and under the loose bark of trees, they have adapted themselves readily to the shelter afforded by the houses of mankind, and find a congenial habitat under the eaves of most dwelling-houses. In fact, wherever an undisturbed dry and darkish receptacle is available they are sure to be discovered, and where allowed to settle prove valuable assistants in keeping down the numbers of the house-flies—the pest of all hot countries.

As members of the family Clubionidæ, they are furnished with ungual tufts, two well pectinated tarsal claws, scopulæ along both tarsi and metatarsi, and have the surface of the maxillæ convex, without any median depression.

The eyes, always eight in number, are disposed in two more or less parallel transverse rows of four each, without much variation in size or relative position.

In Australia the indigenous species have developed a distinctly characteristic type of genital organ. In by far the larger number the stylus in the male palp is produced into a flagellum of remarkable length, sometimes more than twice the length of the cephalothorax; this, for its protection, is curled spirally round a specially grooved drum, and this again has been formed by the rolling up of a riband-like elongation of a projection which, in the *Heteropoda* of a short columnar form only, has had its use as a feeler.

The two parts are quite separate and detachable and can be unrolled. This particular development is unique and, so far as I am aware, entirely confined to the Australian region. The flagellum part of it may be seen more or less developed in other forms such as *Pandercetes*, *Clastes*, and many of the Thomisidæ, and several earlier stages of the more perfect form can be seen, as will be described below.

From their habit of living between the bark and hard surface of trees, nearly the whole subfamily has had the position of the legs so modified as to move horizontally, thus enabling its members to shuffle along without raising the joints. They can thus obtain prey and shelter in narrow interstices where many of

their smaller fellows could not follow. In some instances both cephalothorax and abdomen have likewise become abnormally flattened, accompanied in the more pronounced forms such as *Delena* by a lateral extension of the eyes.

L. Koch originally included in this group the *Hemiclœinæ*, in consequence of a similar and even more exaggerated flattening of the whole body clearly arising from the same habits; but as they are an offshoot of another family, the Drassidæ, they have been rightly separated by M. Simon, and I do not include them in the present paper.

The Australasian genera may be grouped as follows:—

A. Median eyes of the front row distinctly smaller than the laterals, being about three-fifths the diameter of the latter; the area of the four median eyes longer than broad. The highest part of the cephalothorax in the posterior one-third, thence sloping anteriorly; generally no flagellum in the male palp, or, if present, no spiral drum.
  a^1. Rear row of eyes recurved; laterals protuberant .... HETEROPODEÆ.
  a^2 Rear row of eyes straight or procurved; lateral eyes sessile .... PALYSTEÆ.
B. Median eyes of the front row larger than, equal to, or only slightly smaller (about one-fifth of diameter) than laterals of same. The median-eye square not longer than broad (except in *Pediana*). The stylus of the male palp produced into a flagellum, coiled round a supporting drum, which is spirally grooved for its reception. Cephalothorax either quite flat above or highest in front half, thence sloping posteriorly .... DELENEÆ.

Group HETEROPODEÆ.

The members of this group found in Australia at the present time, although probably more like the original type, from which the large bulk of the laterigrade spiders now inhabiting the continent must have been specialized, would seem to be of comparatively recent importation.

The species are all either to be found themselves or have near relatives in the islands to the North and East.

Entering evidently from Cape York, they are most numerous along the coast of Queensland and New South Wales, while a few isolated specimens have been recorded as far as the centre of Victoria, from Adelaide, and from Central Australia.

They show scant signs of compression, and the distance between the two rows of eyes is greater than in the more widely-spread indigenous types, while they are without the spiral conductor and generally without any elongated stylus in the male palp.

The genera may be distinguished as follows:—

A. Rear row of eyes only slightly recurved; median pair of same nearly as far apart as they are distant from the side eyes .... *Heteropoda* Latr.
B. Rear row of eyes strongly recurved. Rear middle eyes about four times as far from the side eyes as from one another (sec. L. Koch) .... *Pandercetes* L. Koch.

Genus Heteropoda Latr.

Heteropoda Latreille, Nouv. Dict. Hist. Nat. xxiv. 1804, p. 135.
Sarotes Sund. Consp. Arach. 1833, p. 28.
Ocypete C. Koch, Uebersicht des Arach. Syst. 1837, p. 27 (ad part.).
Sarotes L. Koch, Ar. Aust. 1875, p. 659.
Heteropoda Latr., Thorell, Rag. Mal. vol. i. 1877, p. 145 et al.
Heteropoda Latr., E. Simon, Hist. Nat. des Ar. 1897, vol. ii. p. 54.

L. Koch (*loc. cit.* p. 709 *et seq.*) described a good many species under the title of *Heteropoda*, none of which, as both Dr. Thorell and M. Simon have shown, conform to Latreille's genus, and they have been removed by M. Simon to *Sparassus* Walck. Furthermore, the species placed by L. Koch under *Sarotes* Sund. really belong to *Heteropoda* Latr., where they are now recorded. To these is added *H. lycodes*, described by Thorell from Cape York under its correct title.

[*Note.*—L. Koch had two species, described as *Sarotes badius* L. Koch (Ar. Austr. p. 662) and *Heteropoda badia* L. Koch (*l. c.* p. 712), both from the Island of Boeroe near New Guinea; as also *Heteropoda hæmorrhoidalis* L. Koch (*l. c.* p. 726). Thorell also described *Sparassus hæmorroidalis* Thor.

To avoid confusion, I may point out that

Sarotes badius L. K. becomes *Heteropoda badia* L. K.
?=*S. malayanus* Dol. (Thor. *l. c.* p. 277).

Heteropoda badia L. K. becomes *Sparassus badius* L. K.
?=*S. mygalinus* Dol. (Thor. *l. c.* vol. ii. p. 189).

Heteropoda hæmorrhoidalis L. K. becomes *Sparassus hæmorrhoidalis* L. K.

Sparassus hæmorrhoidalis Thor. would therefore require a new name if not *Neosparassus punctatus* L. K. (see Thor. *l. c.* vol. iii. p. 259).

From Thorell's description *S. mygalinus* may belong to *Neosparassus*, nov. gen.]

The species may be distinguished as follows:—

A. Abdomen underneath whole-coloured, without any distinguishing markings.	
a^1. Spines above on tibia iii. and iv.	
a^2. On tibia iii. three spines, two on tibia iv. (*sec.* L. Koch)	*jugulans* L. K.
b^2. On tibia iii. and iv. two spines (*sec.* L. K.)	*longipes* L. K.
b^1. No spines above on tibia iv.	
a^3. The median sulcus of cephalothorax short, not reaching down the rear slope (*sec.* L. Koch)	*suspiciosus* L. K.
b^3. The median sulcus very long and reaching down the rear slope.	
a^4. The front and rear middle eyes of equal size	*procerus* L. K.
b^4. The rear middle eyes larger than the front middle	*lycodes* Thor.
B. The abdomen with distinct markings on the underside.	
a^5. Two white stripes on a black shield	*cervina* L. K.
b^5. No black shield.	
a^6. Four narrow dark longitudinal lines; a two-toothed tibial spur on male palp	*regia* Fabr.
b^6. A brown longitudinal stripe below genital fold	*keyserlingi*, nov. sp.

HETEROPODA JUGULANS (L. Koch).

Sarotes jugulans L. Koch, Die Arach. Austr. p. 852 (1876).
Heteropoda jugulans L. Koch, E. Simon, Rev. Spar. 1880, p. 49.

Peak Downs, Queensland. ♂.

HETEROPODA LONGIPES (L. Koch).

Sarotes longipes L. Koch, Die Arach. Austr. p. 660 (1875).
Heteropoda longipes (L. Koch), E. Simon, *l. c.* p. 49.
Sarotes longipes L. Koch, H. R. Hogg in Horn Exped. pt. ii. Zool. p. 339.

Sydney, N.S.W.; ♂ (*Bradley*). Victoria (E. Simon Coll.). Alice Springs, Central Australia (Horn Expedition); ♀.

HETEROPODA SUSPICIOSA (L. Koch).

Sarotes suspiciosus L. Koch, *l. c.* p. 665.
Heteropoda suspiciosa L. Koch, E. Simon, *l. c.* p. 50.

Upolu (*L. Koch*); Rockhampton (*L. Koch*); Newcastle (N.S.W. Mus.); Victoria (*E. Simon*).

HETEROPODA PROCERA (L. Koch).

Ocypete procera L. Koch, Verh. zool.-bot. Ges. Wien, p. 205 (1869).
Sarotes procerus L. Koch, Die Arach. Austr. p. 667 (1875).
Sarotes procerus L. Koch, F. Karsch in Zeitschr. ges. Nat. 1878, vol. li. p. 792.
Heteropoda procera L. Koch, E. Simon, *l. c.* p. 50.

Bowen, Brisbane, Sydney (*L. Koch*); Adelaide (*Karsch*).

HETEROPODA LYCODES Thor.

Heteropoda lycodes Dr. T. Thorell, Ragni Mal. vol. iii. 1881, p. 282.

Cape York.

The co-types in the British Museum of this and *H. cyanognatha* Thor., from Yule Island, are not quite adult, but are undistinguishable from one another.

The measurements in millimetres are as follows:—

	Long.	Broad.
Cephalothorax ...	6	{ 3 in front. / 5
Abdomen	8	5
Mandibles	3 = front patella.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	2	7	8	7	=	24
	2.	2	$7\frac{1}{2}$	9	$7\frac{1}{2}$	=	26
	3.	2	6	7	6	=	21
	4.	2	7	7	7	=	23
Palpi		1	$2\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{1}{2}$	=	$9\frac{1}{2}$

HETEROPODA CERVINA (L. Koch).

Sarotes cervinus L. Koch, Die Arach. Austr. p. 673.

Heteropoda cervina L. Koch, E. Simon, *l. c.* p. 50.

Rockhampton, Port Mackay, Bowen, Sydney (*L. Koch*); Peak Downs (*Keys.*).

HETEROPODA REGIA (Fabr.).

Aranea venatoria Linn. Syst. Nat. edit. xii. p. 1035 (1758).

Aranea regia Fabr. Ent. Syst. ii. p. 408.

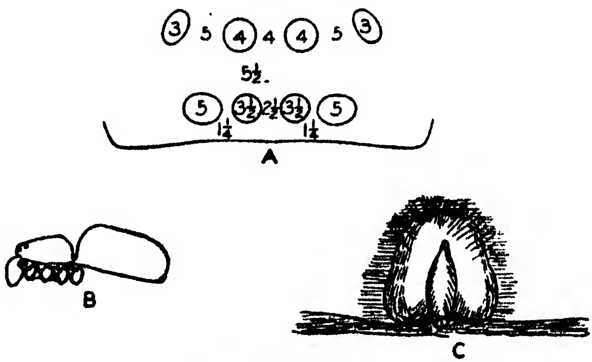
Heteropoda venatoria Linn., Dr. T. Thorell, Rag. Mal. ii. 1878, pp. 191, 205, iii. 1881, p. 274.

Heteropoda venatoria Linn., E. Simon, Rev. Spar. 1880, p. 48.

Heteropoda regia Fabr., E. Simon, Hist. Nat. des Ar. 1897, p. 54.

All tropical and sub-tropical regions.

Text-fig. 85.*



Heteropoda keyserlingi.

A, eyes of female; B, profile; C, epigyne.

HETEROPODA KEYSERLINGI, nov. sp. (Text-fig. 85.)

The cephalothorax is a rich reddish brown, with a curved brown patch around the rear slope; mandibles red-brown, with long pale brown bristles. Lip and maxillæ paler reddish brown, with dark brown hair on outer side of latter. Sternum orange with brown hair. Legs and palpi bright yellow-brown underneath, rather redder on upper side. Abdomen orange mottled with brown, a brown irregular patch in front; underneath paler orange, with a well-defined brown stripe from below the genital fold nearly to the spinnerets.

The *cephalothorax* is steep at the rear slope, thence runs in a straight slope to the eyes, rather narrow in front.

The front row of *eyes* is slightly recurved, the median pair

* The figures inserted in the diagrams of eyes represent tenths of millimetres.

two-thirds diameter apart and one-third from the laterals, which are one and a half times the diameter of the former. The rear row, also recurved, has the median pair one diameter apart, slightly larger than the front median, one and a quarter diameter from laterals, which are as large as the front laterals, and about the same distance from front median. The clypeus equals the diameter of the front side-eyes.

There are four teeth on the lower edge of the falx-sheath and three on the upper.

There are two spines on the upper side of metatarsi iii. and iv., and a scopula to the base of the metatarsi on all legs.

The *abdomen* is oval, sparsely covered with short thin down-lying hair.

The *epigyne* is a chitinous oval frame, the median portion narrow anteriorly and widening to the base, completely filled with a long convex fold of tissue much larger than in L. Koch's drawing of *H. cervina*.

The measurements in millimetres are as follows:—

	Long.	Broad.
Cephalothorax ...	8	{ 4 in front. / $7\frac{1}{2}$
Abdomen	12	8
Mandibles	4 (longer than patella i.).	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	$3\frac{1}{2}$	9	10	9	=	$31\frac{1}{2}$
	2.	$3\frac{1}{2}$	9	11	$9\frac{1}{2}$	=	33
	3.	3	8	9	$8\frac{1}{2}$	=	$28\frac{1}{2}$
	4.	3	9	9	9	=	30
Palpi...............		$1\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$	=	15

Two females from Peak Downs, Queensland, in Keyserling Coll., Brit. Mus., marked *H. cervina*.

Genus Pandercetes.

Pandercetes L. Koch, Ar. Austr. 1875, p. 739; Thor., Ragni Malesi, 1881, p. 309; E. Simon, Hist. Nat. des Ar. vol. ii. p. 56 (1897).

Type, *P. gracilis* L. Koch.

Pandercetes gracilis L. Koch, *loc. cit.* p. 740.

Described by L. Koch from male from Port Mackay, Queensland.

Thorell doubtfully ascribes to this species a male from Cape York (d'Albertis Coll.), and from same collection has two species—*P. isopus* from N. Guinea, and *P. longipes* from Jobi Island, on N. coast of same.

The male of *Pandercetes gracilis* L. K. has (*sec.* L. Koch and E. Simon) a long twisting flagellum on palp, but no supporting stylus or drum.

Group PALYSTEÆ.

The group *Palysteæ* is represented by *Palystes* only.

Genus PALYSTES L. Koch.

Helicopis L. Koch, Die Arach. Austr. i. p. 495 (1874).

Palystes L. Koch, Die Arach. Austr. vol. ii. p. 701 (1875); E. Simon, Rev. Spar. 1880, p. 42, et Hist. Nat. des Ar. vol. ii. p. 65 (1897).

Type species, *Palystes castaneus* (Latr.) (*P. frenatus* L. Koch).

PALYSTES IGNICOMUS L. Koch (*loc. cit.*).

Described from a female from New Ireland, east of N. Guinea.

In the British Museum are a male and female, brought by Mr. A. Willey from New Britain (same locality), doubtless the same as L. Koch's, and a female (Keyserling Coll.) from Brisbane, the latter not quite adult.

Of the former pair the female is much richer in colouring, pale yellow stripes on darker ground down the sides of the abdomen and two round black spots on back, with pale yellow spot in between. Underneath the deep orange femora are dark brown stripes reaching from the anterior end two-thirds of the distance to posterior end; a dark brown shield on the underside of abdomen below the genital fold.

The male, which is smaller, is uniformly pale orange and without any shield; the legs are much thinner, but nearly as long as those of the female.

In both specimens the front side-eyes are much larger than and touch the middle pair, which are half their diameter apart. Eyes all pale orange.

In the Brisbane specimen, which I first thought must be different, the colouring is not so deep, the dark stripes underneath femora are absent as in male above, and the abdominal shield much fainter. The rear row of eyes also is slightly procurved, in the others straight.

I append measurements (in millimetres) of all three:—

Female (N. Ireland).

	Long.	Broad.
Cephalothorax ...	12	{ 6½ front. 10
Abdomen	14	9
Mandibles	5	=pat. i.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	4½	15	18	16½	=	54
	2.	4½	15	17	15	=	51½
	3.	4	11½	12½	11½	=	39½
	4.	4	13½	13½	13½	=	44½
Palpi		2	5	5½	4	=	[illegible]

Male.

	Long.	Broad.
Cephalothorax ...	8	{ 4 / 7
Abdomen	$8\frac{1}{2}$	5
Mandibles	$3\frac{1}{2}$ =less than front pat.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	3	$14\frac{1}{2}$	$18\frac{1}{2}$ (5, $13\frac{1}{2}$)	17	=	53
	2.	3	$14\frac{1}{2}$	17	17	=	$51\frac{1}{2}$
	3.	3	11	11	10	=	35
	4.	3	13	13	13	=	42
Palpi		$1\frac{1}{2}$	5	5	4	=	$15\frac{1}{2}$

Female (Brisbane).

	Long.	Broad.
Cephalothorax ...	12	{ 7 / 10
Abdomen	13	9
Mandibles	5	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	4	$14\frac{1}{2}$	$18\frac{1}{2}$	18	=	55
	2.	4	14	$18\frac{1}{2}$	$16\frac{1}{2}$	=	53
	3.	4	11	$12\frac{1}{2}$	12	=	$39\frac{1}{2}$
	4.	4	$13\frac{1}{2}$	$14\frac{1}{2}$	$14\frac{1}{2}$	=	$46\frac{1}{2}$
Palpi		2	5	6	5	=	18

Group Deleneæ.

I adopt *Delena* as the type genus of a group in preference to leaving the Australian genera incorporated with M. Simon's *Sparasseæ*, because the former genus exhibits the most complete type of differentiation both in its flattened form and in the Australian type of male palp. By the latter point these genera and *Neosparassus* are, as far as we have seen the males, entirely distinguishable from the type species of the genus *Sparassus* Walck. (*S. argelasius* of Southern Europe), so that for the Australian members of that genus I have established the new genus *Neosparassus*. To this, provisionally, I transfer those forms recently classed as *Sparassus*, but, until all the males have been proved to conform to it, its limits cannot be accurately defined, and it further remains a moot point whether any boundary-line can be drawn between it and *Isopeda*. The species at present associated with the genus will be those ascribed by L. Koch to *Heteropoda*, as above stated, erroneously. *Neosparassus diana* L. K. is a good representative of the genus. Through *N. salacius* L. K. it runs very closely into *Isopeda* L. K.

The latter genus, while very constant in the respective sizes of

its eyes as well as in the form of the male palp and epigyne of the female, has almost every intermediate gradation between a moderately curved and quite flat cephalothorax. The two undoubted species of *Holconia* Thor., *H. immanis* and *H. insignis*, differ from *Isopeda* solely in being the extreme representatives of the series in flatness of the cephalothorax, while in structural features they are otherwise undistinguishable. In the only specimens I can find to attribute to L. Koch's *H. dolosa*, the cephalothorax is not even noticeably flat, and a northern species, *H. subdola* Thorell, is only very doubtfully attributed by him thereto. I have therefore amalgamated the genus with *Isopeda* L. K.

In all the genera except *Pediana* the median eye-area is at least not longer than broad, generally distinctly broader, but in the latter it is longer than broad. For this reason, although the rear row of eyes is clearly procurved, it has been included by M. Simon among the *Heteropodeæ*. *Isopeda horni* mihi belongs to this genus, and two new species from Western Australia bring the number of its members to four. I have not been able to obtain a male of any of my species; but the epigyne of the female is so distinctly of the *Isopeda* type, that it appears more probable than not that all the males will prove to be provided with a spiral flagellum and drum, and this is the case in *P. regina*, the type species, as described by Thorell. The first and second pairs of legs are nearly equal in length, and in the larger species are barely Laterigrade in mode of setting. The eye-space is raised up all round, and, although worthy of a distinctive genus, where it diverges from *Isopeda* it does so almost more in the direction of *Mithurga* Thor. than towards *Heteropoda* Latr.

Its beard alone could hardly, I think, entitle *Typostola* E. Sim. to rank as a separate genus, but the shortness of the palpal spiral distinguishes it from all the species of *Isopeda*, where the number of turns is generally about ten, but here only three.

A primitive *Delena* from King's Island (Bass's Straits), in which the spiral is quite rudimentary, both stylus and conductor making only a single turn, and the tibial apophysis is single instead of double, also necessitates a new genus. Except in its smaller size, it is otherwise scarcely distinguishable from *Delena cancerides* Walck., and clearly suggests the direction along which the present modification has been derived.

The genera may be separated as follows:—

A. The middle eyes of the front row much nearer to one another than to the side-eyes, and clearly larger than the latter. Cephalothorax very flat and low. Pars cephalica divided from the thoracic part by deep impressions, forming an acute angle.

- a^1. Spiral of male palp having about ten convolutions. A double apophysis on anterior end of tibial joint .... *Delena* Walck. (7)
- a^2. Spiral of male palp with only one convolution. Apophysis at anterior end of tibial joint single only .... *Eodelena*, nov. gen.

B. Eyes of front row differing slightly or not at all in relative distance. The side-eyes generally not smaller than the median.

- b^1. Median eye-space clearly longer than broad . — *Pediana* E. Sim. (2)
- b^2. Median eye-space not longer than broad.
  - b^3. Cephalothorax clearly convex, generally set on to the abdomen at an angle so that the anterior portion is higher than the rear. Clypeus at least as broad as the front middle eyes .. .. — *Neosparassus*, nov. gen. (1)
  - b^4. Cephalothorax flat on the top or only slightly convex, set on to the abdomen so that the front and rear portions are about level. Clypeus generally not so wide as front middle eyes.
    - b^5. Cephalothorax longer than broad. . .. — *Zachria*. (3)
    - b^6. Cephalothorax not longer than broad.
      - b^7. Inner side of mandibles and outer side of maxillæ covered with thick mat of hairs, many of which are bifid .. — *Typostola* E. Sim. (5)
      - b^8. Having no special mat, but long hairs thinly covering the whole surface of the mandibles and maxillæ (except *I. vasta*). — *Isopeda* L. Koch. (4)

Genus Neosparassus, nov.

Heteropoda L. Koch, Ar. Austr. 1875 (non Latr.).

Heteropoda F. Karsch, Zeitschr. f. ges. Naturwiss. 1878, p. 809, ad partem *H. patellata*.

Sparassus T. Thorell, Ragni Austro-Malesi, 1881, notes pp. 255, 274 (at least in part).

Sparassus E. Simon, Rev. Spar. (Actes Linn. Soc. Bordeaux, 1880); id. Hist. Nat. des Ar. vol. ii. p. 46 (1897) (in part).

Of the genera included in the group *Deleneæ* the members of this genus come nearest to *Heteropoda* Latr., with which they were included by L. Koch. Neither the cephalothorax nor abdomen show any signs of compression; the coloration and patterns are often vividly bright and varied, and the patterns of the female vulva are of rather diversified form, though roughly a sunken area, more or less divided longitudinally by a wedge-shaped ridge, enclosed in a chitinous frame. The male palps, however, in all the species of which I have been able to obtain specimens, are of the spiral conductor and flagellum type, more or less elaborated and varying from two or three spirals in *N. calligaster* Thor. and *N. diana* L. K., to nine or ten in *N. salacius* L. K.

The *cephalothorax* is generally high, the highest point of the curve being between the eye-space and middle of cephalothorax, thence sloping posteriorly, and in this differs from *Heteropoda* Latr., where L. Koch placed the species. Owing, however, to the angle at which the cephalothorax is often set on to the abdomen, the front part appears more prominent than it really is with respect to the plane of its legs.

Besides the palpal difference from the type species of *Sparassus*, they differ in having legs in order 2 1 4 3, instead of 4th longer

than 1st, and in not having the cephalothorax highest in posterior third. The front side-eyes are generally not larger than the median. Until we know the males of all the species now included provisionally, for which a good deal more collecting is required, we cannot settle the whole of the species for certain.

The species may be distinguished as follows:—

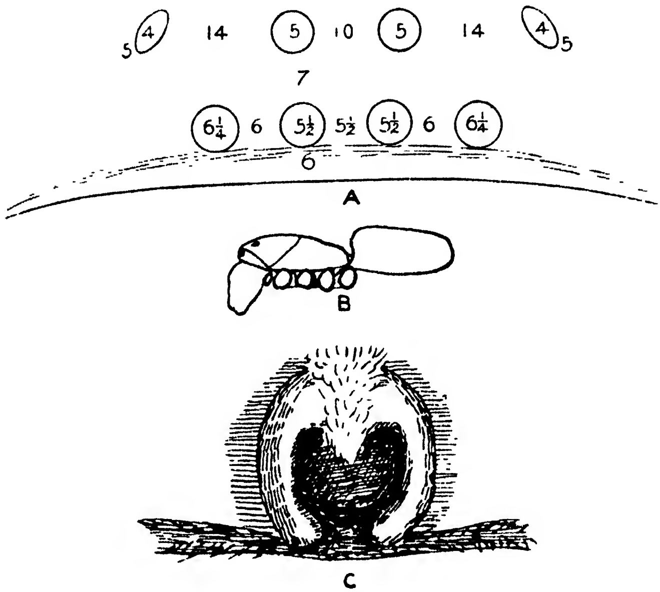
A. Side-eyes of front row larger than median.
  Abdomen above and below pale yellow, with very fine hairs .... *magareyi*, nov. sp.

B. Side-eyes of front row not larger than median.
  a^1. Side-eyes of front row smaller than median.
    a^2. Abdomen underneath whole-coloured, without special markings.
      a^3. Abdomen twice as long as broad, a longitudinal median dark stripe the whole length of back (*sec.* L. Koch) .... *macilentus* L. K.
      b^3. Abdomen at most $1\frac{1}{2}$ times as long as broad, without the longitudinal median stripe above (*sec.* L. Koch) .... *pallidus* L. K.
    b^2. Distinct markings on underside of abdomen.
      a^4. Shield-pattern behind epigyne
        a^5. black, with two white longitudinal stripes thereon (*sec.* L. Koch) .... *pictus* L. K.
        b^5. reddish brown, darker anteriorly, bounded by pale brown border all round. Cephalothorax highest posteriorly .... *thoracicus*, nov. sp.
      b^4. No black shield behind epigyne,
        a^6. but an orange-yellow transverse stripe (*sec.* L. Koch) .... *præclarus* L. K.
        b^6. Underside of abdomen dark orange-yellow; in front of the spinnerets a broken transverse band of yellowish-white hair .... *rutilus* L. K.
        c^6. Longitudinal brown median stripe on pale yellow ground from middle of back to spinnerets; irregular small dark brown spots on underside .... *inframaculatus* Hogg.
  b^1. Eyes of front row of equal size.
    a^7. Eyes of front row equidistant.
      a^8. Median sulcus wanting on cephalothorax .... *festivus* L. K.
      b^8. Median sulcus clearly defined.
        a^9. On the underside of abdomen no black field,
          a^{10}. but two brighter longitudinal stripes .... *hæmorrhoidalis* L. K.
          b^{10}. four brighter longitudinal stripes .... *incomtus* L. K.
        b^9. On the underside of abdomen a black field,
          a^{11}. with two white longitudinal stripes or spots.
            a^{12}. Inside the black field two white longitudinal stripes and a black stripe at base of abdomen on underside .... *diana* L. K.
            b^{12}. The two white longitudinal stripes, one each side, but outside the black field .... ? *pictus* L. K., var., or n. sp.
          b^{11}. No white spots accompanying the black field.
            a^{13}. The black field reaching two-thirds of way down .... *calligaster* L. K.
            b^{13}. A straight black stripe halfway down on orange ground (*sec.* Karsch) .... *patellatus* Karsch.
            c^{13}. The black field broken in the middle transversely, thus forming two .... *salacius* L. K.
    b^7. The front middle eyes farther from the side-eyes than from one another.
      a^{14}. On the underside of the abdomen a black longitudinal field reaching to the spinnerets, but separated transversely in the middle (*sec.* L. Koch) .... *conspicuus* L. K.

b^{14}. On the underside of the abdomen the black field reaching only two-thirds of distance to spinnerets, and bordered by two white lines (*sec.* L. Koch) . .. . *punctatus* L. K.

c^{14}. Two white longitudinal stripes on the underside, without a black field (*sec.* L. Koch) .. . *nitellinus* L. K.

Text-fig. 86.



Neosparassus magareyi.

A, eyes; B, profile; C, epigyne.

NEOSPARASSUS MAGAREYI, nov. sp. (Text-fig. 86.)

Cephalothorax dull red-brown, darker in eye-space, light yellow hair; mandibles black-brown, yellowish-white bristles; lip and maxillæ dark red-brown, light red fringes; sternum orange-brown, light orange hair; legs and palpi bright yellow-brown darkening towards extremities, light yellowish bristly hair; abdomen pale greenish yellow all over, rather thickly covered above with stout pale yellow hair, underneath finer and yellower; spinnerets yellow; epigyne brown; the femora underneath are yellow mottled with brown spots; the tibia yellow and brown, alternate bands.

The *cephalothorax* is 1 mm. broader than long, broad and truncate anteriorly, rising from the eye-space to nearly halfway, thence sloping posteriorly, the transverse section rises rather abruptly, fovea slight. The mandibles are long and powerful, longer than front patella, and thickly covered with long hair.

The front row of *eyes* is slightly procurved, the medians one diameter apart and slightly more from the side-eyes, the same from the margin of the clypeus, and more still than that from the rear median. The front side-eyes are clearly larger than the median. The rear row of eyes are equal and a little smaller than the front median, the middle pair two diameters apart and nearly three from the side.

On the underside of the falx-sheath are two very large, one median and one small tooth, one large and one small on upperside.

The *legs* are rather stout, and furnished with long and powerful spines on tibia iii. and iv., one each.

The *abdomen* is ovate, broadest one-third distance from front and tapering to spinnerets.

Measurements in millimetres.

	Long.	Broad.
Cephalothorax ...	14	{ 9½ in front. 13
Abdomen	15	12
Mandibles	7	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	5	15	17	16	=	53
	2.	5	16	18	17	=	56
	3.	4	13	13	12	=	42
	4.	4½	14	14	14	=	46½
Palpi		2	6	5	5	=	18

Numerous females, but no males, brought from the Northern Territory of S. Australia by Dr. Magarey in 1880. One female, and one male not fully developed, in Brit. Mus. from Port Stephen.

NEOSPARASSUS THORACICUS, nov. sp. (Text-fig. 87.)

This powerful spider I provisionally include in this genus, with which and with *Thelcticopis* and *Isopeda* it has analogies, but differs in the shape of the cephalothorax; I think it ought to have a new genus but that it partially links the others.

The cephalothorax is red-brown, black-brown in front; mandibles, lip, and maxillæ black-brown, sternum and coxæ bright red-brown; legs and palpi somewhat darker, with long brown hair; the abdomen dark brown above and below.

The *cephalothorax* rises steeply from the sides, is highest posteriorly and slopes forwards to the eye-space, it is 2 mm. longer than broad and broadly truncate in front.

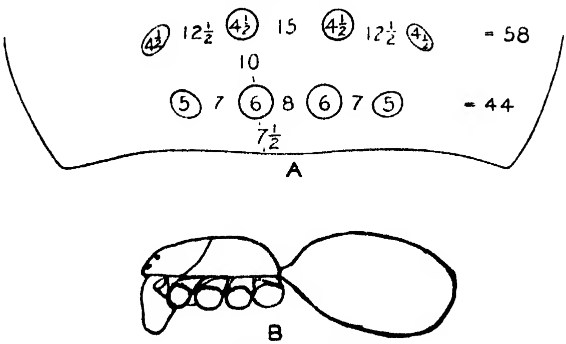
The front median *eyes* are about 1½ diameters apart, rather more from the rear median, one diameter from the laterals, which are clearly smaller. The clypeus is wider than the front median eyes. The rear row is procurved, the median eyes wider apart than from the laterals, which are about the same size as the front laterals, the median somewhat smaller.

The *mandibles* are long and stout.

The *abdomen* is oval, but the specimen is dried and it is stuffed with wool, and so the epigyne is destroyed. It is rather closely covered with thick short hair.

The *legs* are very stout, and altogether it is a formidable species.

Text-fig. 87.



Neosparassus thoracicus, ♀.

A, eyes; B, profile.

Measurements in millimetres.

	Long.	Broad.
Cephalothorax ...	18	{ 10 / 16
Abdomen	22	17
Mandibles	8	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	6	17	22	20	=	65
	2.	6	18	23	21	=	68
	3.	5½	15½	16½	14½	=	52
	4.	5½	16	17	17	=	55½
Palpi		3½	7	8½	6	=	25

One dried female in Brit. Mus. from N. Australia.

Neosparassus macilentus (L. Koch).

Heteropoda macilenta L. Koch, Arach. Austr. vol. ii. p. 711.

One female from Bowen.

L. Koch thinks this should possibly be included in the genus *Isopeda*.

Neosparassus pallidus (L. Koch).

Heteropoda pallida L. Koch, *loc. cit.* p. 713.

One male from Peak Downs.

NEOSPARASSUS PICTUS (L. Koch).

Heteropoda picta L. Koch, *loc. cit.* p. 714.

Australia (*L. Koch*). ? Var. Dimboola, Victoria (*Hogg*); ♀. ? Adelaide and West Australia (*Karsch*).

NEOSPARASSUS PRÆCLARUS (L. Koch).

Heteropoda præclara L. Koch, *loc. cit.* p. 723.

Rockhampton and Gayndah; ♂ & ♀.

NEOSPARASSUS RUTILUS (L. Koch).

Heteropoda rutila L. Koch, *loc. cit.* p. 729.

Bowen; ♀.

NEOSPARASSUS INFRAMACULATUS (Hogg).

Heteropoda inframaculata Hogg, Rep. Horn, Exp. vol. ii. Zool. p. 343.

Central Australia.

NEOSPARASSUS FESTIVUS (L. Koch).

Heteropoda festiva L. Koch, *loc. cit.* p. 710.

Sydney; female undeveloped.

NEOSPARASSUS HÆMORRHOIDALIS (L. Koch).

Heteropoda hæmorrhoidalis L. Koch, *loc. cit.* p. 726.

Sydney; female undeveloped.

NEOSPARASSUS INCOMTUS (L. Koch).

Heteropoda incomta L. Koch, *loc. cit.* p. 727.

Sydney; ♀.

NEOSPARASSUS DIANA (L. Koch).

Heteropoda diana L. Koch, *loc. cit.* p. 730.

The male palpal spiral has about three turns. For the type of my new genus I have taken this very beautifully coloured species, or at any rate the specimens in my collection which I identify as *N. diana* (L. Koch).

Macedon, Dimboola, Victoria; Adelaide; Perth.

Widely distributed over the whole of the southern half of Australia.

NEOSPARASSUS CALLIGASTER (Thor.).

Heteropoda calligaster Thorell, Ar. nonnullæ Nov. Holl., Öfv. K. Vet.-Akad. Förh. 1870, no. 4, p. 385; L. Koch, Die Arach. Aust. p. 734.

Peak Downs, Queensland; Sydney, N.S.W. (*Koch*); Dimboola, Victoria (*H. R. H.*); Adelaide (*Karsch*).

NEOSPARASSUS PATELLATUS (Karsch).

Heteropoda patellata F. Karsch, Zeit. ges. Naturw. Berlin, vol. li. 1878, p. 809.

Sec. Karsch, near the above-named *N. calligaster* (Thor.); but without any special distinction is a little doubtful.

Loc. Tasmania.

NEOSPARASSUS SALACIUS (L. Koch).

Heteropoda salacia L. Koch, Die Arach. Aust. p. 737.

Sparassus salacius Thorell, Rag. Mal. vol. iii. 1881, p. 255.

This rather large species has a broad transverse black band in front of spinnerets as well as shield behind genital fold. The male palp flagellum has 10 spirals; and although the species is brightly coloured (yellow and black) like a *Sparassus*, it has very little to differentiate it from *Isopeda*.

Cape York; Rockhampton; Bowen; Peak Downs; Sydney; Upper Endeavour River, Queensland (*Hogg*).

NEOSPARASSUS CONSPICUA (L. Koch).

Heteropoda conspicua L. Koch, Die Arach. Aust. p. 717.

Bowen; ♀.

NEOSPARASSUS PUNCTATUS (L. Koch).

Sparassus punctatus L. Koch, Besch. n. Ar. & Myr., Verh. k.-k.-zool.-bot. Ges. Wien, 1865, p. 872.

Heteropoda punctata L. Koch, Die Arach. Aust. p. 719.

Sparassus punctatus Thor. Rag. Mal. vol. iii. 1881, p. 259.

Cape York (*Thor.*); Bowen, Port Mackay, Wollongong, Rockhampton, Peak Downs, Sydney (*L. Koch*); Dimboola, Victoria, Central Australia (*Hogg*).

NEOSPARASSUS NITELLINUS (L. Koch).

Heteropoda nitellina L. Koch, Die Arach. Aust. p. 722.

Peak Downs; ♀.

Genus ISOPEDA L. Koch.

Isopeda L. Koch, Die Arach. Austr. vol. ii. p. 678 (1875).

Voconia Thor. Araneæ nonnullæ Nov. Holl., in Öfv. Kongl. Vet.-Ak. Förh. 1870, no. 4, p. 383.

Holconia Thor. Rag. Mal. e Pap. vol. i. 1877, note p. 145.

Isopoda Thor. Rag. Mal. e Pap. vol. iii. 1881, note p. 293.

Isopoda E. Simon, Rev. Sparass. 1880.

Holconia E. Simon, Hist. Nat. des Ar. vol. ii. p. 44.

Type species, *Isopeda vasta* L. Koch.

This genus, both in number of specimens as a whole as well as of species (or subspecies), is by far the most largely represented of the group in Australia. Its limitations are not very clearly defined, but certainly include Thorell's genus *Holconia*. It would

appear to have been developed in Australia proper, and few of its members have strayed away thereform.

The whole of its species have the male palpal spiral in its most fully developed form with about 10 spirals.

The *cephalothorax* is set on straight with the body; in altitude it is generally less than any member of the preceding genera, and in profile varies from a continuous curve highest about the middle to a flat surface. The latter form comprises two, or perhaps three, species hitherto known as *Holconia* (*Voconia*) Thor., but which, except for the flatter cephalothorax and consequently lower clypeus, differ in no particular from the rest of the *Isopedæ*. Thorell himself was doubtful how to place his northern form, *H. subdola* Thor.; and in the only specimens I have seen to attribute to *H. dolosa* L. Koch, the cephalothorax is quite as normally rounded as many other species of *Isopeda*.

In a few instances the eyes of the front row, which is straight or slightly procurved, are all equal, but more generally the laterals exceed the median in diameter in the proportion of about 5 to 4. The rear row is also straight or slightly procurved, about a third longer than the front row, the rear median eyes always smaller than any of the others, and either rather nearer together than they are from the lateral, or equidistant.

The median eye-square is broader than long.

The cephalothorax is as broad as or broader than long and straight in front, where it is generally about two-thirds the greatest width. The legs always in the proportion 2 1 4 3.

NOTE.—The name *Isopeda* L. Koch has given rise to some discussion at various times in consequence of its being certainly wrongly formed from the Greek. Thorell and Simon set it down to a *lapsus calami* and boldly write *Isopoda*, but L. Koch uses his original form a score of times (and never any other) within a few pages of *Heteropoda*, also used by him over and over again. It certainly was no *lapsus calami* but deliberately intended. He probably knowingly spelt it wrongly to avoid clashing with the order of Crustacea *Isopoda*. The name is altogether a misnomer as applied to this genus, for no two pairs of legs of any of the species are alike in length.

The only species which had two pairs of legs (i. and ii.) of equal length has been removed to a new genus (*Pediana* E. Sim.), though for other reasons.

Synopsis of Genus Isopeda *L. Koch.*

Females.

A. Sternum deep jet-black.
- A[1]. Underside of abdomen whole-coloured, without any transverse dark stripe behind the genital fold.
  - a^1. Eyes of front row equidistant.
    - a^2. Distinguishable markings on back of abdomen.
      - a^3. Three pairs of dark spots on whole-coloured back of abdomen; coarse hair on abdomen, rather coarse on cephalothorax; cephalothorax longer than tibia i. .... *frenchi*, nov. sp.

b^3. No spots, dark brown median scolloped stripe on back, fine hair on cephalothorax and abdomen; cephalothorax equal tibia i. in length. *leishmanni*, nov. sp.

b^2. No distinguishable markings on whole-coloured back of abdomen.

a^4. No spines on upperside of tibia iii. or iv.

a'^4. A brown and yellow impressed shield-pattern on underside of abdomen .. ... *montana*, nov. sp.

b'^4. No shield pattern, darker and lighter mottlings (*sec.* L. Koch) . .. . *conspersa* L. K.

b^4. One spine on upperside of tibia iii., none on iv.; no pattern on underside of abdomen. *pococki*, nov. sp.

b^1. Median eyes of front row nearer to side-eyes than to one another.

a^5. Median eyes of rear row nearer to one another than to laterals; two spines on tibia iii. above, one on tibia iv. .. ... *tepperi*, nov. sp.

b^5. Eyes of rear row equidistant; one spine each on tibia iii. and iv. (*sec.* L. Koch) *flavida* L. K.

B^1. A black transverse band behind the genital fold.

a^6. Front median eyes less than their diameter from those of rear row . *leai*, nov. sp.

b^6. Front median eyes *not* less than their diameter from those of the rear row.

a^7. Eyes of front row equal and equidistant.

a^8. Mandibles bare in front; one spine above on tibia iii. . ... *vasta* L. K.

b^8. Mandibles more or less clothed with hair.

a^9. Dark spot in front of abdomen; one spine on tibia iii. above ... . *pengellya*, nov. sp.

b^9. A scolloped longitudinal stripe on back; two spines on tibia iii. above, none on tibia iv. . ... *saundersi*, nov. sp.

c^9. No pattern on back; two spines on tibia iii. above, one on tibia iv. . ... *ardrossana*, nov. sp.

b^7. Eyes of front row not equidistant.

a^{10}. Median eyes of front row nearer to side than to one another: one spine above on tibia iii. *pesslери* ? Thor.

b^{10}. Median eyes of front row nearer to one another than to side.

a^{11}. No spines on tibia iii. or iv. above; four pairs of spots on back, median pairs joined . . .. *villosa* L. K.

b^{11}. One spine on tibia iii. above, none on iv.; no marks on back ... . *tietzi*, nov. sp.

B. Sternum red-brown or yellow-brown or at least not black.

a^{12}. Cephalothorax convex or at least slightly raised behind the eye-space and sloping posteriorly.

a^{13}. Median eyes of front row clearly farther from the side-eyes than from one another.

a^{14}. Front median eyes their diameter apart and same distance from the rear median .... *robusta* L. K.

b^{14}. Front median eyes $\frac{3}{4}$ diameter apart and full diameter from the rear median; three pairs of spots on back, median pair a longitudinal line .. .. *woodwardi*, nov. sp.

b^{13}. Front row of eyes equidistant.

a^{15}. The cephalothorax as long as tibia iv. (*sec.* L. Koch)................. .... *hirsuta* L. K.

b^{15}. The cephalothorax longer than tibia iv.

a^{16}. On femur i. in front four spines; cephalothorax about 3 mm. long (*sec.* L. Koch) ... *cordata* L. K.

b^{16}. On femur i. in front three spines at most.

a^{17}. Abdomen above clothed with long, stiff, bristly hair (spider very large) .... *aurea* L. K.

b^{17}. Abdomen above clothed with fine hair only (*sec.* L. Koch) .... *flavibarbis* L. K.

b^{12}. Cephalothorax low, or if raised at sides, quite flat above.
a^{18}. Front row of eyes straight or slightly procurved; eyes about equidistant.
a^{19}. A dark stripe reaching from front of abdomen two-thirds of distance to rear; front and rear middle eyes not more than the diameter of front median apart .... *immanis* L. K.
b^{19}. No dark stripe on back of abdomen but irregular darker transverse bands; front lateral eyes larger than median, front and rear median farther apart than diameter of front eyes ... . *insignis* Thor.

Doubtful species .. { *dolosa* L. K. / *subdola* Thor.

Males.

A. Sternum deep jet-black.
A^{1}. No transverse black band behind genital fold.
a^{1}. Eyes of front row equidistant, laterals larger than median.
a^{2}. No spines on tibia iii. or iv. .. .. *montana*, nov. sp.
b^{2}. Spines on tibia iii. at least.
a^{3}. Two spines on tibia iii. above, one on iv. . *leishmanni*, nov. sp.
b^{3}. One spine on tibia iii. only; eyes black with orange rims .... *pococki*, nov. sp.
b^{1}. Median eyes of front row about twice as far apart as they are distant from the laterals.
a^{4}. Median eyes of front row less than their diameter apart; two spines above on tibia iii. and on tibia iv. .... *tepperi*, nov. sp.
b^{4}. Median eyes of front row about one and a half diameters apart; pale green with black rims. One spine each on tibia iii. and iv. above . .. *flavida* L. K.
B^{1}. A transverse black band behind genital fold.
a^{5}. Eyes of front row equidistant, equal in size; mandibles bare in front. One spine on tibia iii. above .. .. *vasta* L. K.
b^{5}. Eyes of front row not equidistant. Median eyes nearer to side-eyes than to one another.
a^{6}. One spine above on tibia iii. and iv. ... . . . *pessleri* Thor.
b^{6}. Two spines above on tibia iii., one on iv. . ... *tietzi*, nov. sp.
B. Sternum not black—red or yellow-brown. No spines above on tibia iii. or iv. Front row of eyes equal and equidistant; front and rear median nearer to one another than diameter of front.
a^{7}. No stripe on back .. .. *insignis* Thor.
b^{7}. Longitudinal stripe on back .. .. *immanis* L. K.

ISOPEDA INSIGNIS (Thor.). (Text-fig. 88, A–C.)

Voconia insignis Thorell, Ar. nonnullæ Nov. Holl., Öfv. Kongl. Vet.-Akad. Förh. 1870, n. 4, p. 383.

Voconia insignis Thor., L. Koch, Arach. Austr. 1875, p. 645.

Holconia insignis Thor., E. Simon, Rev. Sparass. p. 25 (1880); Hist. Nat. d. Ar. 1897, vol. ii. p. 44.

This fine species except in the flatter cephalothorax, differs in no way from the rest of the *Isopedæ*, and therefore I find no use for the genus *Holconia* Thor. as a distinction.

In the female the front lateral eyes are distinctly larger than the median, which are distant from the rear median not less than the breadth of their diameter, more often rather more. In the

males the front row eyes are equal and equidistant, about half their diameter apart, the median less than their diameter from the rear median.

The abdomen is bright yellow-brown above, with fine darker hair, sometimes forming a scolloped or transversely barred pattern; four pairs of muscle-spots not very clearly defined. The median pairs sometimes conjoined by a dark line.

It ranges over the southern half of the continent.

The following measurements in millimetres are from South Australian specimens:—

Female.

	Long.	Broad.
Cephalothorax ...	15	15½
Abdomen	24	17½
Mandibles	7 shorter than front patella.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	6	18	8, 14 (22)	20	=	66
	2.	6	21	27	24	=	78
	3.	6	16	16	16	=	54
	4.	6	16	16	16	=	54
Palpi...............		3	6½	6½	6½	=	22½

Male.

	Long.	Broad.
Cephalothorax ...	12	12
Abdomen	11½	9½
Mandibles	4½	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	4½	16	19	19	=	58½
	2.	4½	18½	22	21	=	66
	3.	4½	15	16½	15	=	51
	4.	4½	15	16½	16½	=	52½
Palpi...............		2½	5	4	4	=	15½

Loc. New South Wales; Victoria; South Australia; West Australia.

Isopeda immanis L. Koch. (Text-fig. 88, D, p. 434.)

Delena immanis L. Koch, Verh. z.-b. Ges. Wien, p. 208 (1867).

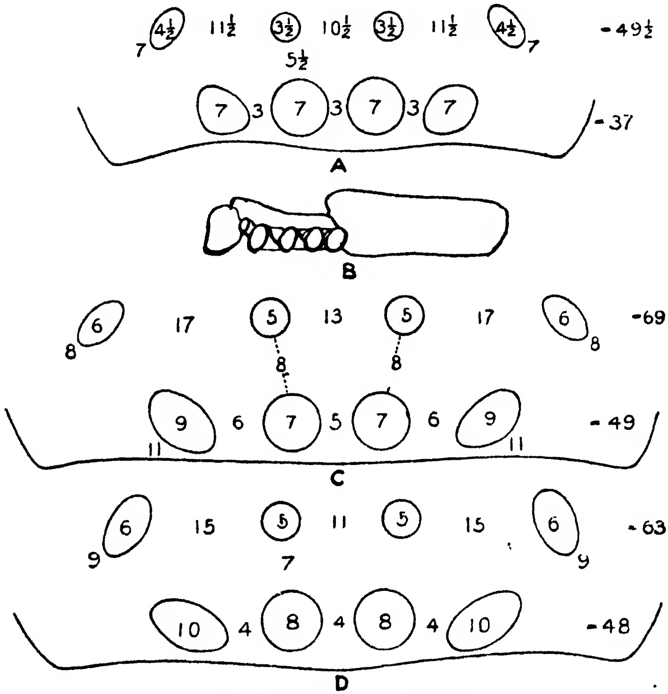
Voconia immanis L. Koch, Ar. Austr. 1875, p. 642.

Holconia immanis E. Simon, Rev. Spar. 1880, p. 26.

This is the northern form of the above, and, although Dr. Karsch quotes it from South and West Australia, out of a considerable number of specimens I have not myself seen one of *I. immanis* from the South, nor of *I. insignis* from the North of Australia. This form has a very characteristic dark stripe on the back of the abdomen, reaching from the front two-thirds of the distance to the rear. In other respects the two species differ very little. The distance between the front and rear median eyes in the

female is generally less than the diameter of the front median (as in the male), sometimes equal; the diameter of the front laterals varies from about equal to that of the median to $1\frac{1}{4}$ of same. The colour of the back varies from yellow-brown to dark grey.

Text-fig. 88.



Isopeda insignis and *I. immanis*.

A, eyes of male; B, profile; C, eyes of female of *I. insignis*. D, eyes of female of *I. immanis*.

Female (J. J. Lister, S. Queensland).

	Long.	Broad.
Cephalothorax ...	13	{ 8 in front. 13
Abdomen	24	17
Mandibles	6	= less than front patella.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	6	$16\frac{1}{2}$	21	19	=	$62\frac{1}{2}$
	2.	6	19	25	21	=	71
	3.	6	$14\frac{1}{2}$	$16\frac{1}{2}$	15	=	52
	4.	6	$14\frac{1}{2}$	$16\frac{1}{2}$	15	=	52
Palpi		$2\frac{1}{2}$	5	5	5	=	$17\frac{1}{2}$

Male (Keyserling Coll. in Brit. Mus.).

	Long.	Broad.
Cephalothorax ...	13	13
Abdomen	14	10
Mandibles	6	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	5	18	23 (7, 16)	$22\frac{1}{2}$	=	$68\frac{1}{2}$
	2.	5	21	27	25	=	78
	3.	5	14	18	$16\frac{1}{2}$	=	$53\frac{1}{2}$
	4.	5	14	18	18	=	55
Palpi...............		3	5	5	7	=	20

Loc. Queensland and New South Wales.

ISOPEDA DOLOSA L. Koch.

Voconia dolosa L. Koch, Arach. Austr. 1875, p. 648.

L. Koch described this species from two dried specimens in the Museum at Stuttgart, labelled "Australia" only. The differences by which he says it may be distinguished from *I. insignis* Thor., are that "the clearly smaller median eyes of the front row are more than their diameter from the rear median," and the joining by a dark longitudinal marking of the two median pair of muscle-spots on the back. The latter feature seems a by no means uncommon variation in any species, whenever the back spots are specially well developed, and the former is almost universally the case with females of *I. insignis* Thor. I have therefore great doubts as to it being really a separate species; if it is, the joining of the back spots is its only distinctive character. The Horn Expedition had several specimens from Central Australia, both male and female, with back-markings as described, very flat cephalothorax, but front row of eyes equal, and I have similar from Victoria, otherwise the same as *I. insignis*.

ISOPEDA SUBDOLA Thor.

Holconia subdola Thorell, Rag. Mal. e Pap. vol. iii. 1881, p. 304.

Thorell himself describes this as a doubtful species, the only difference from Koch's description of *H. dolosa* being in the coloration of the back of the abdomen.

From Cape York, N. Queensland.

ISOPEDA CONSPERSA L. Koch.

Isopeda conspersa L. Koch, Arach. Austr. 1875, p. 689.

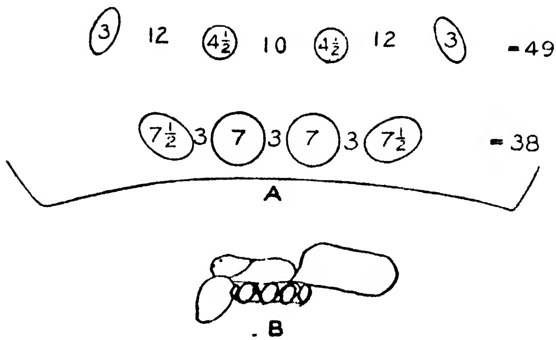
From Cape York.

ISOPEDA FRENCHI, nov. sp. (Text-fig. 89, p. 436.)

Female.—The cephalothorax is red-brown with yellow hair, the mandibles rather darker with bright red fringes. Lip and maxillæ black-brown. Sternum jet-black, with velvety-black hair

extending over nearly the whole of the coxæ. The abdomen is yellow-brown, somewhat lighter underneath, and three pairs of dark spots visible on upperside; four impressed longitudinal lines behind epigyne. Legs and palpi red-brown with yellow hair; a nearly black spot on the underside of tibiæ i. and ii. anteriorly, remainder silvery. Scopulæ grey.

Text-fig. 89.



Isopeda frenchi.

A, eyes of female; B, profile.

The *cephalothorax* in front is two-thirds its greatest width.

The front row of *eyes* is equal and equidistant, half a diameter from margin of clypeus. The distance between front and rear median greater than the diameter of front eyes. Rear median farther from the side-eyes than from one another.

On tibia iii. above are two spines, none on tibia iv.

The hair on the abdomen is somewhat coarse.

Measurements in millimetres.

	Long.	Broad.
Cephalothorax ...	11	{ 6½ in front. / 11
Abdomen	14	11
Mandibles	5 = front patella.	

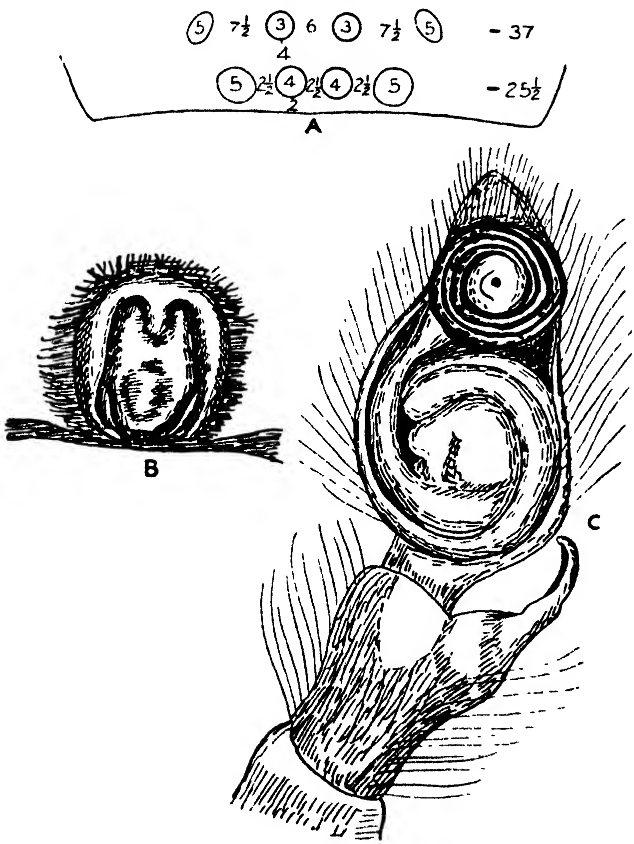
		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	5	12½	13½	13½	=	44½
	2.	5	13½	15	13½	=	47
	3.	5	10	11½	10	=	36½
	4.	5	11	11½	11½	=	39
Palpi..............		2	4½	4½	4½	=	15½

Three females and one undeveloped male from Dimboola, Victoria, I have named after Mr. C. French, Government Entomologist of Victoria, from whom I received them.

Three females in the South Australian Museum Collection from

Victoria have the same proportions, but there are no visible spots on the back, the sternum and coxæ are dark brown and not black, the hair on the abdomen is rather finer, with wavy darker and lighter streaks on the sides of the abdomen, and one spine only instead of two on tibia iii. I do not think these differences are sufficient to justify a new species.

Text-fig. 90.



Isopeda leishmanni.
A, eyes; B, epigyne; C, male palp.

ISOPEDA LEISHMANNI, nov. sp. (Text-fig. 90.)

Female.—Cephalothorax and mandibles red-brown, with yellowish-grey hair. Lip and maxillæ red-brown. Sterr um dark brown, with nearly black hair. Abdomen dingy reddish brown with greyish-yellow hair, lighter on the underside. A darker brown median longitudinal stripe with scolloped pattern is just

visible. Legs and palpi red-brown, with thin long greyish-yellow hair; the coxæ the same colour.

The *cephalothorax* is slightly broader than long, and as long as tibia i., in front not quite two-thirds its greatest width. The thoracic fovea is deep and long, the divisions between the cephalic part and thoracic scarcely visible; the cephalothorax sloping gently from sides to middle, is rounded but not high.

The front row of *eyes* are equidistant, two-thirds the diameter of the front median apart, the side larger than the median, which are their diameter from the rear median and half that from margin of the clypeus. The rear median are farther from the laterals than from one another. The first tooth on inner side of falx-sheath is larger than the other.

There is one spine above on tibia iii., none on iv.

The *male* has no distinguishable stripe on back; the front eyes are equal and equidistant, rather more than half a diameter apart, their diameter distant from the rear middle, which are farther from the side than from one another.

Two spines above on tibia iii. and one on tibia iv.

Measurements in millimetres.

Female.

	Long.	Broad.
Cephalothorax ...	9	{6, 9½}
Abdomen	15	10
Mandibles	4½ less than front patella.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	4	12	5, 8½ (13½)	12½	=	42
	2.	4	12	15	13½	=	44½
	3.	4	9½	10	9½	=	33
	4.	4	10½	11	11	=	36½
Palpi..............		2	4½	4	4½	=	15

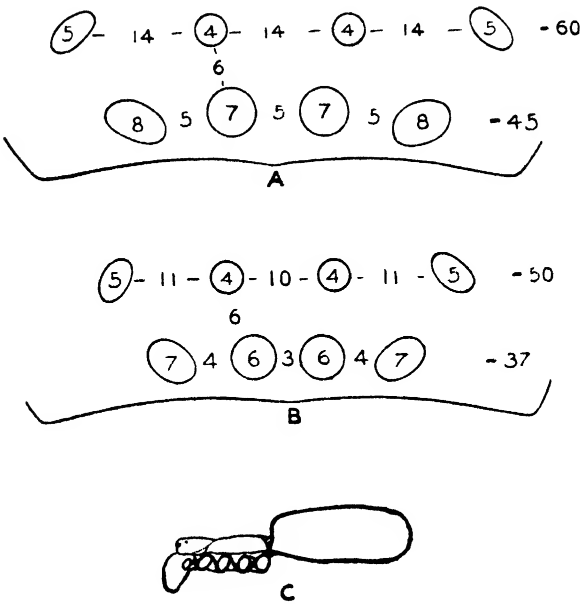
Male.

	Long.	Broad.
Cephalothorax ...	11½	{6½, 11½}
Abdomen	13	12
Mandibles	6½ = patella i.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	5½	16	6½, 13½ (20)	18	=	59½
	2.	5½	17	21½	19	=	63
	3.	5½	14	15	13	=	47½
	4.	5½	14	16	15	=	50½
Palpi..............		2½	5½	4	5	=	17

Albany, King George's Sound, W. Australia (*Mrs. Leishmann*). A male from Perth, W. Australia, is larger and legs slightly longer in proportion, but otherwise not distinguishable (in Brit. Mus. Coll., sent by Mr. H. W. J. Turner).

Text-fig. 91.



Isopeda montana.

A, eyes of female; B, eyes of male; C, profile (of female).

Isopeda montana, nov. sp. (Text-fig. 91.)

Male & Female.—Cephalothorax and mandibles red-brown, with yellow-brown hair; lip and maxillæ black-brown with pale front edges. Sternum black-brown with dark brown hair, but not extending over coxæ; the latter, legs and palpi light red-brown, with pale brown upstanding hair. Abdomen dingy yellow-grey above, somewhat mottled, rather thick, long, fine grey or yellow-grey hair, with a dark brown spot in front, and three pairs of muscle-spots. Underside greyish yellow, with brown circles round gill-covers, and brown streaks forming a distinct shield-pattern. White underneath patella and lower half of tibia i. and ii.

The *cephalothorax* slopes gradually from the sides, flat above; fovea long, divisions between thoracic and cephalic parts scarcely distinguishable. Cephalothorax as long as tibia i.; mandibles shorter than patella i.

The front row of *eyes* is straight, nearly equidistant, three-fourths of a diameter apart, their diameter between front and rear median; rear median farther from side than from one another in male, equidistant in female. Clypeus one-third of front median.

The first tooth on inner side of falx-sheath large, two next moderate, fourth very small.

There are no spines above on tibia iii. and iv. The metatarsal joint of tibial palp of male is distinctly broad.

Measurements in millimetres.

Male.

	Long.	Broad.
Cephalothorax ...	10	6 / 11
Abdomen	11½	8½
Mandibles	5	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	4	13	5, 11 (16)	15	=	48
	2.	4	14	18	16	=	52
	3.	4	11	12½	11	=	38½
	4.	4	11	13	12½	=	40½
Palpi		2	4½	3½	4½	=	14½

Female (not fully developed).

	Long.	Broad.
Cephalothorax ...	8½	5 / 8½
Abdomen	9½	6
Mandibles	3½	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	3	10½	12	11	=	36½
	2.	3	11½	15	12	=	41½
	3.	3	9	10	9	=	31
	4.	3	9	10	10	=	32
Palpi		1½	4	3	4	=	12½

Loc. Macedon, Victoria.

Isopeda pococki, nov. sp. (Text-fig. 92.)

Cephalothorax dark red-brown; mandibles, lip, maxillæ, and sternum almost black-brown. Legs and palpi dark red-brown, with brown hairs all over. Abdomen yellow-brown above, reddish brown underneath; very thick, long, coarse hair; no pattern.

The *cephalothorax* is rather sloping at the sides, steep at rear, convex above. A long fovea followed by a depression almost to second row of eyes. Cephalic side-depressions clearly marked.

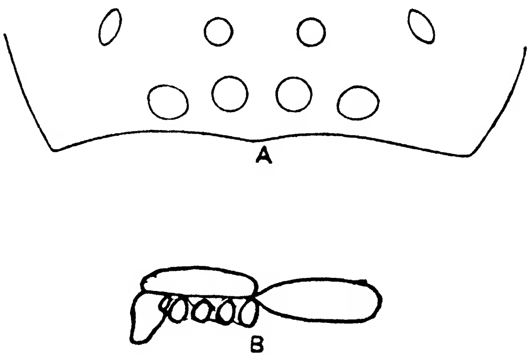
The front row of *eyes* is slightly procurved, equidistant; side-

eyes larger than median, the latter slightly more than their diameter from those of the rear row, which are nearer to one another than to their laterals. Clypeus about equals diameter of front median eyes.

One spine on tibia iii. above, none on tibia iv.

The metatarsal scopula only reaches halfway to base on i., ii., and iii., one-fourth on iv.

Text-fig. 92.



Isopeda pococki.

A, eyes; B, profile.

Measurements in millimetres.

Female.

	Long.	Broad.
Cephalothorax ...	14	9 14
Abdomen	18	12
Mandibles	7 = front patella.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	6	16	7, 11 (18)	17	=	57
	2.	6	18	19	19	=	62
	3.	5	16	15	13	=	49
	4.	5	15	15	15	=	50
Palpi..............		3	6	5	5	=	19

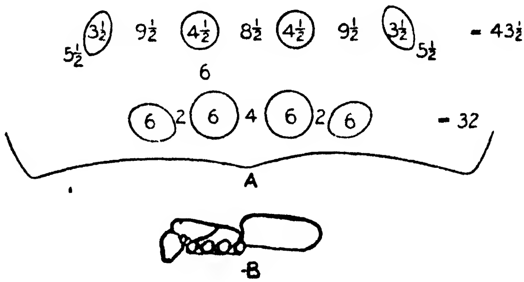
Male.

	Long.	Broad.
Cephalothorax ...	12	7½ 12
Abdomen	12	7
Mandibles.........	5½ shorter than front patella.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	5	17	7, 13 (20)	19	=	61
	2.	5	19	23	21	=	68
	3.	4	14	16	14	=	48
	4.	4	15	16	16	=	51
Palpi..............		$2\frac{1}{2}$	5	4	6	=	$17\frac{1}{2}$

Two dried specimens, Australia only, in Brit. Mus. Coll.

Text-fig. 93.



Isopeda tepperi.
A, eyes of female; B, profile.

ISOPEDA TEPPERI, nov. sp. (Text-fig. 93.)

This species differs very slightly from Thorell's and L. Koch's description of *Isopeda pessleri* Thor. But it has no transverse stripe behind the genital fold. In the Adelaide specimens the front side-eyes in the female, as in the male, are somewhat larger than the median, and the latter nearer to the side than to one another. Two spines above on tibia iii. and iv. instead of one. In the Kangaroo Island female the front row eyes are all equal, and tibia iv. has only one spine, which brings it still nearer to *I. pessleri*.

The *cephalothorax* is red-brown; the mandibles, lip, and sternum black-brown with yellowish hair and bristles.

The *sternum* is black, with black hair extending over the two front coxæ and partially over the two rear.

The *abdomen* is yellowish-brown, with rather coarse matted hair, three pairs of muscle-spots showing on the upper side, and a slightly impressed shield-pattern on the under.

Measurements in millimetres.

Female.

	Long.	Broad.
Cephalothorax ...	9	{ 6 / 9
Abdomen	11	8
Mandibles	4	shorter than pat. i.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	4	10	4½, 7 (11½)	10½	=	36
	2.	4	11	13	11	=	39
	3.	4	9	9	8	=	30
	4.	4	9½	9½	9½	=	32½
Palpi		2	4	3	3	=	12

Male.

	Long.	Broad.
Cephalothorax ...	9	{ 5 / 9
Abdomen	8	5½
Mandibles	4 = pat. i.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	4	11	5, 9 (14)	12½	=	41½
	2.	4	12	14½	13½	=	44
	3.	4	10	11	10	=	35
	4.	4	10½	11½	11½	=	37½
Palpi		2	3½	3	4½	=	13

Loc. ♂ & ♀, Adelaide (*Noack*); ? Kangaroo Island (*Tepper*).

Isopeda flavida L. Koch.

Isopeda flavida L. Koch, Die Arachn. Austr. 1875, p. 686.

In the Keyserling Collection, British Museum, is a non-adult male, and I have several females (all young) apparently the same from Macedon, Victoria. The eyes are green on black rims. On all (young) there is one spine above on tibia iii. but none on tibia iv.

The measurements of Keyserling's male are as follows:—

	Long.	Broad.
Cephalothorax ...	5	5
Abdomen	4	3
Mandibles	2	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	2	6½	8½	7½	=	24½
	2.	2	6½				
	3.	2	6	6½	6	=	20½
	4.	2	6½	6½	6½	=	21½
Palpi		1½	2	2	3	=	8½

Loc. Bowen, Sydney, Macedon.

Isopeda vasta L. Koch.

Isopeda vasta L. Koch, Die Arachn. Austr. 1875, p. 681.

In the Keyserling Collection is an adult male and subadult female, both from Brisbane.

The mandibles of both are smooth and broad, the female remarkably rounded and kneed at base.

There is a black sloping streak at the base of femur i., and a similar dark brown streak at base of tibia i.

In both sexes a spine on tibia iii. above, none on iv.

Measurements in millimetres.

Female.

	Long.	Broad.
Cephalothorax ...	8½	{5½ 8½
Abdomen	11½	8½
Mandibles	4	2½

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	3	9	4½, 6½ (11)	10	=	33
	2.	3	10½	12½	11	=	37
	3.	3	7	9	7	=	26
	4.	3	8	9	9	=	29
Palpi		2	3¾	3	3	=	11¾

Male.

	Long.	Broad.
Cephalothorax ...	7	7
Abdomen	7½	5½
Mandibles	3	2 = pat. i.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	3	10	12½	12	=	37½
	2.	3	12	14½	14	=	43½
	3.	3	9½	8	8	=	28½
	4.	3	10	8½	10	=	31½.
Palpi		2	4	2½	4½	=	13

ISOPEDA PESSLERI Thor.

Isopeda pessleri Thor. Ar. non. Nov. Holl., Öfv. K. Vet.-Akad. Förh. 1870, no. 4, p. 684.

Isopeda pessleri L. Koch, Die Arachn. Austr. 1875, p. 684.

Loc. Queensland and New South Wales. Some South (Adelaide Mus.) and Central (Horn Exp.) Australian specimens are very close to this, but larger, and probably not the same.

ISOPEDA VILLOSA L. Koch.

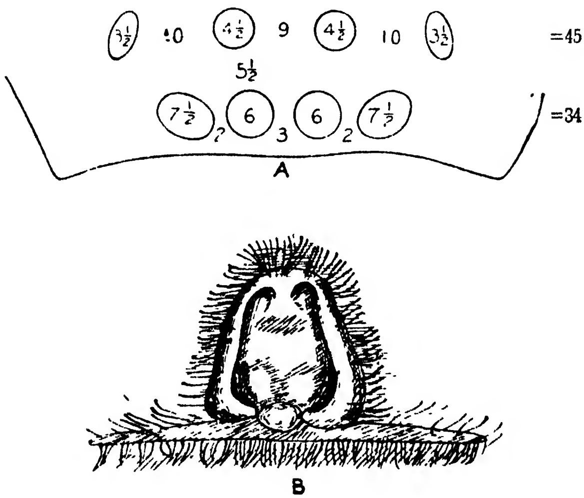
Isopeda villosa L. Koch, Die Arachn. Austr. 1875, p. 687.

Loc. Sydney (*L. K.*). Specimens from Victoria and South Australia I attribute to this—they have eight spots on back, two middle pairs conjoined; also a female sent by Dr. Broom from Muldiva, Queensland. The latter measures in millimetres:—

	Long.	Broad.
Cephalothorax ...	12½	{ 8 / 12½
Abdomen	19	14
Mandibles	6	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	4½	12½	6½, 9½ (16)	14½	=	47½
	2.	4½	14½	18	15½	=	52½
	3.	4½	12	12	10½	=	39
	4.	4½	12½	12½	11	=	40½
Palpi		3	4¼	5	4¾	=	17

Text-fig. 94.



Isopeda leai.
A, eyes of female; B, epigyne.

ISOPEDA LEAI, nov. sp. (Text-fig. 94.)

Female.—The cephalothorax and mandibles are red-brown, the latter with greyish-yellow bristles; the lip and maxillæ dark brown; sternum black-brown, the dark hair spreading over the coxæ. The abdomen is pale brown, with a darker brown scolloped longitudinal stripe above; yellow with brown irregular spots below; a faint dark stripe behind epigyne. The legs and palpi are reddish covered with fine silky brownish-yellow hair. The underside of patella and middle of tibia i. and ii. silvery white, brown each end; scopulæ dark grey.

The *cephalothorax* is rounded, moderately high, depression

between cephalic and thoracic parts well marked, median sulcus rather long.

The front row of *eyes* is straight, the laterals are larger than the median, which are half their diameter apart and the same or rather less from the side; the clypeus barely one-third their diameter; the front and rear median are barely the diameter of the latter apart, the diameter of the rear three-fourths of front; rear row straight; middle eyes two diameters apart and slightly more from the laterals.

The teeth on the inner falx-sheath are three large and one very small.

One spine above on tibia iii., none on tibia iv.

Measurements in millimetres.

	Long.	Broad.
Cephalothorax ...	9	{ 6 in front. 9
Abdomen	16	10½
Mandibles.........	4 less than front patella.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	3½	10	4½, 9½ (12)	12	=	37½
	2.	3½	12	13	12	=	40½
	3.	3½	9	10	9	=	31½
	4.	3½	9½	10	10	=	33
Palpi		1½	4	3½	3½	=	12½

One female from Adelaide, sent to Brit. Mus. by Rev. T. S. Lea.

This species is rather close to *I. frenchi*, nov. sp., from Victoria, and *I. saundersi*, nov. sp., from West Australia, both of which have the same deep velvety-black sternum, the colour extending partly over the coxæ. It differs from both in a rather smaller cephalothorax, in the eyes of both front and rear rows being nearer together, the side-eyes larger than median of front row, and closer together than in the former.

ISOPEDA ARDROSSANA, nov. sp. (Text-fig. 95.)

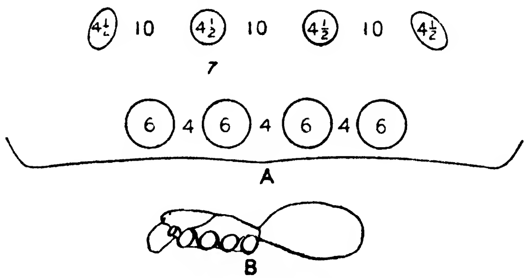
Female.—The cephalothorax is red-brown; mandibles dark red-brown with long pale yellow hair; lip and maxillæ dark brown; sternum black-brown with long thick hair extending over coxæ. The abdomen is dingy yellow-brown above, paler below, with a transverse black band behind the epigyne. The legs and palpi are bright orange with long silky hair, darker bands on tibiæ i., ii., and iii., silver in between and under patella; scopulæ dark grey.

The *cephalothorax* is flatter than in *I. leai*, to which also it is rather close, but the front-row eyes are equal and equidistant, two-thirds of their diameter apart; the medians rather more

than their diameter from those of the rear row, which are also equidistant, more than twice the diameter of rear median apart, these are three-fourths the diameter of front eyes; clypeus one-half of front median.

There are two spines above on tibia iii. and one on tibia iv., of one leg only, the other having no mark.

Text fig. 95.



Isopeda ardrossana.

A, eyes of female; B, profile.

Measurements in millimetres.

	Long.	Broad.
Cephalothorax ...	11	$\begin{cases} 6\frac{1}{2} \\ 11 \end{cases}$
Abdomen	16	11
Mandibles	5	= front patella.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	4	13	14½	13	=	44½
	2.	4	14	17	14	=	49
	3.	4	11½	12	10½	=	38
	4.	4	11½	13	12	=	40½
Palpi		3	4½	4	4½	=	16

One female in South Australian Museum Collection, sent by Mr. E. H. Cadd from Ardrossan, South Australia.

Isopeda pengellya, nov. sp. (Text-fig. 96, p. 448.)

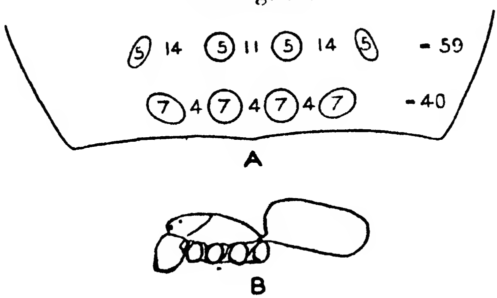
Female.—Cephalothorax bright red; mandibles, lip, and maxillæ red-brown with greyish-yellow hair; sternum dark brown with dark brown hair, paler in front. Abdomen brownish yellow with dark brown spots in front, behind which darker brown with brown hairs in thick transverse stripes; a dark brown stripe reaches from the anterior end into the dark brown mass. Underside yellow-brown with irregular small brown spots, a narrow dark transverse stripe behind genital fold, and a faint broad shield-depression. Legs bright orange-brown above, duller underneath, thick yellowish upstanding hair; dark grey scopulæ.

Cephalothorax somewhat high, sloping from sides and rear in an almost continuous curve transversely and longitudinally. In front two-thirds the greatest breadth.

Front row of *eyes* straight; laterals only slightly larger than median, equidistant, three-quarters of diameter of median apart, front and rear median the diameter of front side-eyes apart; clypeus half of front median; rear median eyes nearer to one another than to the side-eyes.

On tibia iii. above is one spine, none on tibia iv.

Text-fig. 96.



Isopeda pengellya.
A, eyes of female; B, profile.

Measurements in millimetres.

	Long.	Broad.
Cephalothorax ...	$11\frac{1}{2}$	7 / $11\frac{1}{2}$
Abdomen	14	11
Mandibles.........	5 shorter than pat. i.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	$4\frac{1}{2}$	$13\frac{1}{2}$	$6\frac{1}{2}$, 10 ($16\frac{1}{2}$)	14	=	$48\frac{1}{2}$
	2.	$4\frac{1}{2}$	15	18	$15\frac{1}{2}$	=	53
	3.	$4\frac{1}{2}$	12	13	$11\frac{1}{2}$	=	41
	4.	$4\frac{1}{2}$	12	13	13	=	$42\frac{1}{2}$
Palpi		2	5	$4\frac{1}{2}$	$4\frac{1}{2}$	=	16

One female from Pengelly, West Australia, and two from Darling Ranges, West Australia, sent by Mr. B. H. Woodward.

Isopeda saundersi, nov. sp. (Text-fig. 97.)

Female.—Cephalothorax and mandibles dull red-brown; lip and maxillæ dark brown, fringes orange; mandibular bristles greyish yellow; sternum black-brown, with thick matted hair extending over coxæ. Abdomen greyish yellow, with longitudinal scolloped

brown stripe, yellower underneath with short pale yellow hair; darker stripe behind epigyne, more or less developed in different specimens. Legs and palpi dull reddish brown, pale yellow-grey hairs; dark grey scopulæ.

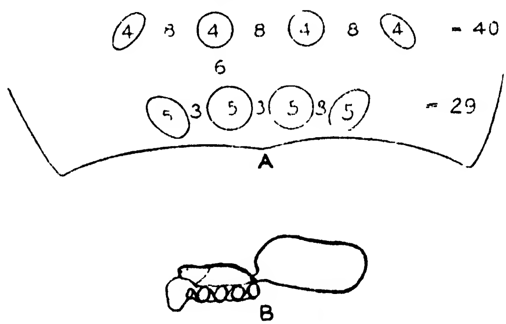
The *cephalothorax* is moderately high, rounded rather broadly in front. *Mandibles* short and broad, much rounded at base.

The *eyes* of the front row are nearly equal and equidistant, three fifths diameter apart and same distance from the margin of the clypeus. The rear row is slightly procurved, the eyes are equidistant, twice the diameter of their median apart, which are four-fifths diameter of front. The front and rear medians are distant one and a half times the diameter of the rear median.

The *legs* are short and stout. Two spines above on tibia iii., but where sometimes missing the mark of posterior spine is not visible, none on tibia iv.

The scopula on metatarsus iv. thins off towards the base.

Text-fig. 97.



Isopeda saundersi.

A, eyes of female; B, profile.

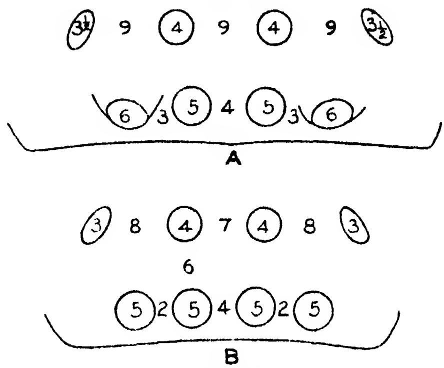
Measurements in millimetres.

	Long.	Broad.
Cephalothorax ...	9	{ 5½ / 9 }
Abdomen	15	11
Mandibles	4 = front patella.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	3	9½	11	10½	=	34
	2.	3	10½	12	11	=	36½
	3.	3	8	9	8	=	28
	4.	3	8	9½	9½	=	30
Palpi		1½	3½	3½	3½	=	12

Two females from Chapman River, West Australia, were sent to Brit. Mus. by Mr. W. Saunders.

Text-fig. 98.



Isopeda tietzi.
A, eyes of female; B, eyes of male.

ISOPEDA TIETZI, nov. sp. (Text-fig. 98.)

Female. -Cephalothorax red-brown, covered with fine closely-lying yellow hair; mandibles darker red-brown, long yellowish-grey bristles; lip and maxillæ dark red-brown to black-brown; sternum black-brown, with thick velvety-black hair extending over the coxæ. Legs yellow-brown, with dingy yellow hair; silvery-white below the patella, brown at each end, and silvery-white in middle underneath the tibia of first and second pairs, fainter on third and fourth. Abdomen yellow-brown above and below, a dark stripe behind the genital fold and impressed shield-pattern.

The *males* vary from the same colour as the females to lighter yellow-brown and rather lighter mandibles, lip, and maxillæ. In one specimen the eyes are yellow on distinct black rims, in the others all yellow.

The *cephalothorax* is moderately high, and rounded some distance from the sides, a deep and long fovea with faint side striæ. The front row of *eyes* is slightly procurved, the side larger than the middle and only half the distance from them that the latter are from one another. The rear row are equidistant, and the distance between front and rear median greater than the diameter of the front median.

On tibia iii. in the females is one spine above, in the males two on tibia iii. and one on tibia iv.

Measurements in millimetres.

Female (largest).

	Long.	Broad.
Cephalothorax ...	9	$\begin{cases} 5\frac{1}{2} \text{ front.} \\ 9 \end{cases}$
Abdomen	15	11
Mandibles	$4\frac{1}{2}$ shorter than front patella.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	3½	10	12	11	=	36½
	2.	3½	11	13	11½	=	39
	3.	3½	9½	9½	8½	=	31
	4.	3½	10	10	10	=	33½
Palpi		2½	4	4	4	=	14½

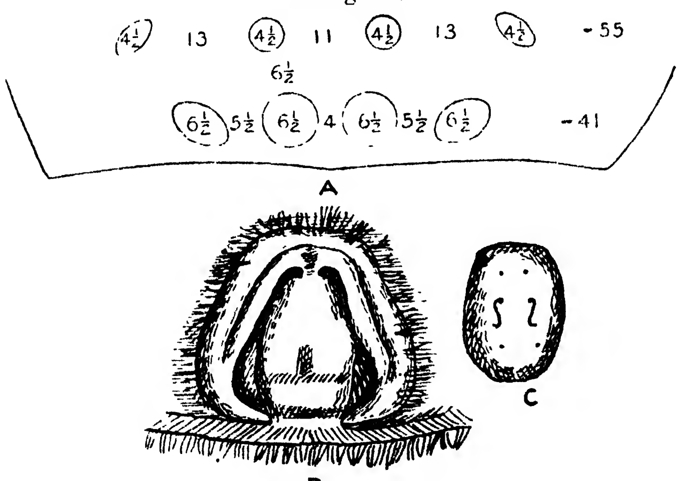
Male (largest).

	Long.	Broad.
Cephalothorax ...	8	{ 4½ / 8
Abdomen	8	6
Mandibles.........	3½	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	3	11	13	13	=	40
	2.	3	13	14	14	=	44
	3.	3	9	9	9	=	30
	4.	3	10½	10½	11½	=	35½
Palpi		2	4	3	5	=	14

Males and females from Adelaide and environs sent to the South Australian Museum by Mr. A. Tietz, and one male from Victoria by Prof. Spencer.

Text-fig. 99.



Isopeda woodwardi.

A, eyes of female; B, epigyne; C, upperside of abdomen.

ISOPEDA WOODWARDI, nov. sp. (Text-fig. 99.)

Female.—Cephalothorax red-brown, darker in front, yellowish hair; mandibles, lip, and maxillæ black-brown, brown bristles,

light red fringes; sternum red-brown, yellowish-brown hair. Abdomen dingy yellow-brown above, brighter below; three pairs of dark spots on back, the anterior and posterior pairs being round, and the median longitudinal lines as described by L. Koch in his *I. dolosa* and *I. villosa*; rather long downlying yellow hair; on the underside only a slightly darker coloured narrow transverse stripe behind the genital fold, and a faint shield-pattern. The legs and palpi are bright reddish brown, with long upstanding brown hair, the scopulæ darker yellowish grey.

The *cephalothorax* is rather flat, rounded at sides and broad in front; clypeus low, with a long and deep median sulcus, but only faint side striæ.

The front row of *eyes* are equal in size, the median pair being nearly two-thirds their diameter apart and nearly half as much again from the laterals, the row being straight, they are their diameter from the median of the rear row, which are two and a half diameters apart (three-quarters of median) and three from their laterals.

There are no spines on the upperside of tibia iii. or iv.

This is very like *Isopeda villosa* L. Koch, and the specimens from Central Australia (Horn Exp. pt. ii., Zool. p. 339) which I took to be *I. dolosa* L. Koch. It differs from the former in the front eyes being equal instead of laterals largest, and the side-eyes farther from middle than the latter are from one another, and the rear median nearer together than their distance from the side; the transverse stripe on the underside of the abdomen and the sternum are not so dark. They also differ from the latter in having the front row of eyes farther apart and not equidistant; legs longer in proportion, and cephalothorax not quite so flat.

Measurements in millimetres.

	Long.	Broad.
Cephalothorax ...	11½	{ 7½ / 11½ }
Abdomen	17½	13½
Mandibles	5½	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	5	13	6, 11 (17)	15	=	50
	2.	5	14½	20	17	=	56½
	3.	5	12	11	10	=	38
	4.	5	11½	13	11½	=	41
Palpi		2½	5	4	5	=	16½

One female from the interior of S. Australia, sent to Brit. Mus. by Mr. H. P. Woodward.

ISOPEDA ROBUSTA L. Koch.

Isopeda robusta L. Koch, Die Arachn. Austr. 1875, p. 69[1].

Koch described this from a single female in the Vienna

Collection. He says the rear middle eyes are $1\frac{1}{2}$ times as far from the laterals as from one another. There are two dried specimens (females) in the Brit. Mus. Collection, without localities, which I refer to this—Koch's specimen had no locality other than Australia.

In those I have examined the eyes are black on yellow rims; except in this, the want of black markings, and the longer distance between median and side rear eyes, it is very near to my *I. woodwardi*, above.

ISOPEDA CORDATA L. Koch.

Isopeda cordata L. Koch, *loc. cit.* p. 694.

Koch described this from a non-adult female from Sydney and distinguishes it by the rear row of eyes being slightly recurved and having no scopula on metatarsus iv.

It has not been recorded since, and is a somewhat doubtful species.

ISOPEDA HIRSUTA L. Koch.

Isopeda hirsuta L. Koch, *loc. cit.* p. 693.

A male from Bowen, Queensland; not recorded since.

Has a light-coloured sternum, flat cephalothorax, no spines on tibia iii. or iv. above; front row of eyes equal and equidistant, very near the margin of the clypeus. It only seems to differ from *I. insignis* Thor. in having the front eyes farther apart.

ISOPEDA AUREA L. Koch.

Isopeda aurea L. Koch, *loc. cit.* p. 696.

Koch described a male and female (both young and undeveloped) from Port Mackay.

There is in the Brit. Mus. Collection a magnificent specimen (female) which I take to be the full-grown of his species, from Queensland also. It is red-brown, thickly covered with pale yellow to orange hair, the femora with brown spots underneath.

The measurements are as follows:—

	Long.	Broad.
Cephalothorax ...	$16\frac{1}{2}$	$\begin{cases}10\frac{1}{2}\\17\end{cases}$
Abdomen	16	14
Mandibles	9	= front patella.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	6	20	25	22	=	73
	2.	7	22	28	24	=	81
	3.	6	17	19	16	=	58
	4.	7	18	18	18	=	61
Palpi		$3\frac{1}{2}$	8	8	7	=	$26\frac{1}{2}$

ISOPEDA FLAVIBARBIS L. Koch.

Described from a non-adult female from Sydney; not recorded since.

Genus ZACHRIA L. Koch.

Zachria L. Koch, Die Arach. Austr. vol. ii. p. 649.
Zachria Simon, Hist. Nat. des Ar. vol. ii. p. 45.

Type, *Z. flavicoma* L. Koch.

As M. Simon remarks, this genus differs from *Isopeda* L. Koch in the somewhat longer cephalothorax.

The two distinguishable species may be diagnosed as follows:—

Abdomen brownish yellow all over, no stripe	*flavicoma* L. Koch.
Abdomen brownish yellow, a darker brown stripe, widest anteriorly and narrowing to rear, the whole length of back from front to spinnerets	*oblonga* L. Koch.

ZACHRIA FLAVICOMA L. Koch.

Zachria flavicoma L. Koch, Arach. Austr. vol. ii. p. 650.

Loc. King George's Sound. Female only described. No record since.

ZACHRIA OBLONGA L. Koch.

Zachria oblonga L. Koch, *l. c.* p. 651.

In the British Museum (Keyserling Collection) is a specimen labelled *Zachria oblonga* L. Koch, from Sydney, a female, which agrees with Koch's description and is no doubt correctly named.

The eyes are in every respect those of an *Isopeda*, the cephalothorax flat above, rather steep at the sides and rear. The epigyne agreed with Koch's drawing, but the specimen was half-moulted, and on removing the skin the new one underneath is of true *Isopeda* form. The mandibles are much kneed at base; three teeth on outer and two on inner falx-sheath.

The measurements in millimetres are as follows:—

	Long.	Broad.
Cephalothorax ...	9	5 in front. / 7
Abdomen	14	8
Mandibles	4	= front patella.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	3	9	$10\frac{1}{2}$	9	=	$31\frac{1}{2}$
	2.	3	10	12	10	=	35
	3.	3	7	9	7	=	26
	4.	3	8	9	8	=	28
Palpi..............		$1\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	=	12

Koch described a *Zachria hæmorrhoidalis* from Sydney from a quite small, not adult female. Judging from his description it appears to be a young specimen of *Z. oblonga*.

Genus Typostola E. Sim.

Typostola E. Sim. Hist. Nat. des Ar. vol. ii. p. 44.

Type species, *T. barbata* (L. Koch).

M. Simon removes this species from *Isopeda* and makes it the type of a new genus on the strength of the somewhat larger size of the rear median eyes compared with the laterals, and the curious development of a mass of very long and stout plumose bristles on the inner side of the mandibles and the outer side of the maxillæ.

In the specimens in the British Museum (two females and a male) the former point is not by any means clearly shown, but in the male palp the spiral support and flagellum are only partially developed, being in fact in the intermediate stage; it is therefore, I think, a quite good genus. The outer mandibular teeth are also five, instead of the four in *Isopeda*. The comparative nearness of the rear middle eyes in some cases makes the eye-square longer than broad.

The female specimens in the British Museum differ from one another in minor points, and considerably from the male. All three, so far as can be judged, are different from L. Koch's *T. barbata*, but it must be remembered that they are all single specimens. The Rev. O. P. Cambridge has a fine female agreeing with the largest *T. magnifica*, which he was good enough to allow me to inspect.

The following synopsis shows the chief points of difference. I am not quite satisfied as to how far *T. major* really differs from *T. barbata* L. Koch, but his drawing of the epigyne, if correct and from a fully adult specimen, should be conclusive.

A. Lip and maxillæ yellow-brown. Rear side-eyes longer than the front laterals and clearly much larger than the rear middle, at least in male. Cephalothorax shorter than tibia iii. . . . . . . *broomi*, nov. sp.

B. Lip and maxillæ dark or nearly black-brown. Front and rear laterals of equal diameter.

- a^1. Lip and maxillæ scarcely any lighter at extremities. Cephalothorax clearly longer than broad, as long as tibia iv. and in front as wide as the mandibles are long .. .. *magnifica*, nov. sp.
- b^1. Lip and maxillæ much lighter at extremities than in the above. Cephalothorax as broad as long, clearly longer than tibia iv., and wider in front than mandibles are long.
  - a^2. The points of the chitinous oval of the epigyne widely apart at base. Rear middle eyes more than one and a half times their diameter apart .. ... *major*, nov. sp.
  - b^2. Chitinous oval of epigyne closed at base (*sec.* Koch). Rear middle eyes only slightly farther apart than their diameter .. . . *barbata* L. Koch.

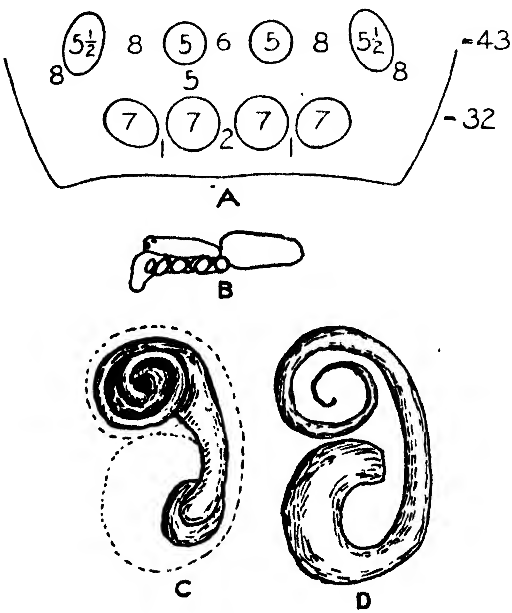
Typostola broomi, nov. sp. (Text-fig. 100, p. 456.)

Cephalothorax, lip, and maxillæ orange-brown; mandibles the same but darker; beard pale orange; sternum and coxæ yellow with pale yellow hair; legs somewhat darker; scopulæ dark grey. Abdomen dingy orange with yellowish-grey hair, both lighter on underside, no signs of any pattern

The *cephalothorax* very slightly longer than broad, narrowing in front to half its width; fovea rather long and deep, with clearly-marked depressions bordering the cephalic part.

The front row of *eyes* are equal in diameter, half of same from margin of clypeus; the median are less than one-third of their diameter apart and only half of the same distance from the laterals, three-fourths of their diameter from the rear medians, which are slightly less than that distance in diameter and slightly farther apart. The rear row is straight, but the laterals are larger than the front laterals and a little farther from their median than the latter are apart. They bear to the latter in diameter the proportion of 8 to 5.

Text-fig. 100.



Typostola broomi.

A, eyes; B, profile; C, support in male palp; D, flagellum of male palp.

There are no spines on tibia iii. and iv. above.

The scopulæ extend thickly to the base of metatarsi i., ii., & iii., and there is further a thick coating of hair on the underside of the tibia to the base of patella. The fourth pair of legs have been reproduced from the coxa and are abnormally small. The underside of the palpi has a thick divided scopula to the base of the femoral joint. The palpal flagellum and supporting-drum have about three spirals only, the latter on account of its shortness being cup-shaped.

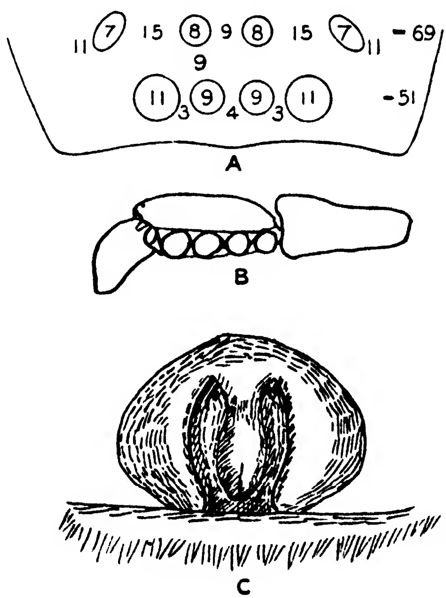
The measurements in millimetres are as follows:—

	Long.	Broad.
Cephalothorax ...	$9\frac{1}{2}$	$\begin{cases} 4\frac{1}{2} \text{ in front.} \\ 9 \end{cases}$
Abdomen	11	8
Mandibles	5 shorter than patella i.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	4	17	21	20	=	62
	2.	4	18	23	22	=	67
	3.	4	12	16	14	=	46
	4.	4	9	12	12	=	37 [1]
Palpi...............		$2\frac{1}{2}$	5	5	$4\frac{1}{2}$	=	17

One male from Muldiva, N. Queensland, sent by Dr. Broom.

Text-fig. 101.



Typostola magnifica.
A, eyes; B, profile; C, epigyne.

TYPOSTOLA MAGNIFICA, nov. sp. (Text-fig. 101.)

Cephalothorax red-brown, somewhat darker about the eye-space; mandibles black-brown; lip and maxillæ dark red-brown, only slightly paler at upper edges, beards pale orange. The sternum and coxæ are bright orange, the front two pairs of the latter being somewhat darker than the posterior, the hair and bristles pale

[1] Abnormal.

yellow. The legs and palpi are red-brown above, paling to lighter red below; general hair-covering yellow, but scopulæ dark grey. The abdomen is a dingy greyish yellow above and below, three pairs of darker spots on the upperside; epigyne dark brown all over.

The *cephalothorax* is clearly broader than long, rounded at sides, square in front, where it is as broad as the rather stout mandibles are long. It is almost flat from the rear row of eyes to the rear slope, but slopes rather gradually from the sides; the median fovea is long and distinct.

The front row of *eyes* is slightly procurved, the laterals being half their diameter from the margin of the clypeus; the medians, which are a little smaller, being three-fourths. They are equidistant, less than one-third of their diameter. The rear row is straight, the laterals the same diameter as front laterals. The median pair are clearly smaller, four-fifths the diameter of front median, from which they are distant rather more than their diameter and the same distance apart, from their lateral they are nearly two of their diameters distant. The median eye-square is rather longer than broad.

The teeth on the mandibular sheath are large and powerful, on the inner side four large and one smaller, on the outer one large and one medium-sized.

The *legs* are long and powerful and somewhat cylindrical; thick scopulæ to base of metatarsi i., ii., and iii., two-thirds of metatarsus iv.; matted hair underneath the other joints except femur.

No spines above on tibia iii. or iv.

The *abdomen* is broadly ovate, covered with a thick mat of downlying hair; on the underside four longitudinal impressed lines form the indication of a shield. The epigyne is a broad oval with wide chitinous margin, and well-formed longitudinal median ridge dividing the inner portion, which is the same dark colour as the outer.

The measurements in millimetres are as follows:—

	Long.	Broad.
Cephalothorax ...	17½	{ 9 / 16½
Abdomen	22	17½
Mandibles	9	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	6	23	9, 22 (31)	28	=	88
	2.	6	25½	35	29	=	95½
	3.	6	19	23½	20	=	68½
	4.	6	20	7, 17½ (24½)	24	=	74
Palpi..............		4	9	9	8½	=	30½

The Rev. O. P. Cambridge has one female with slightly longer legs than this one, sent by Mr. D. Le Souëf to the British Museum; both are from Queensland.

TYPOSTOLA MAJOR, nov. sp.

Cephalothorax red-brown, somewhat darker in front, clothed with short yellow hair, nearly white between the eyes; mandibles black-brown; beard red-brown; lip and maxillæ red-brown, pale in front, fringes orange, beards pale yellow. Sternum and coxæ orange, the front one of latter thickly covered with long yellow hair, others bare. Legs bright reddish brown. Abdomen dark brown with brown hair.

The *cephalothorax* is very slightly longer than broad, distinctly longer than tibia iv., its square front is more than one-half its greatest breadth, and clearly broader than the mandibles are long. The median fovea and those at junction of cephalic part rather indistinct.

Both rows of *eyes* are straight, the laterals equal; the eyes of the front row are equidistant half the diamater of the median which are four-fifths the diameter of side, and their diameter distant from the rear median; the latter are more than once and a half of their diameter apart, being three-fifths of laterals, and more than twice their diameter from the latter. The median eye-square is as broad as long.

The *abdomen* is ovate, truncate in front, thickly covered with coarse downlying hair; three pairs of muscle-spots above and four longitudinal hair-lines on underside as in *T. magnifica*. The epigyne is white in the median area instead of dark-coloured as in the last, and is flat without any median ridge, the points of the horseshoe chitinous frame being well apart as in the *Isopeda* type generally.

The *legs* are comparatively rather shorter than the above and thickly covered with downlying hair; the femora underneath with long upstanding bristles. The palpi are thickly covered with hair on all joints and, without the maxillæ joints, are fully once and a half the length of the cephalothorax. L. Koch gives once and one-third for his *T. barbata*.

There is only one spine above on tibia ii., instead of two as in *T. magnifica*.

The measurements in millimetres are as follows:—

	Long.	Broad.
Cephalothorax ...	$15\frac{1}{2}$	$\begin{cases} 8\frac{1}{2} \\ 15 \end{cases}$
Abdomen	$17\frac{1}{2}$	$13\frac{1}{2}$
Mandibles	$7\frac{1}{2}$ = front patella.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	6	20	25	$23\frac{1}{2}$	=	$74\frac{1}{2}$
	2.	6	22	28	25	=	81
	3.	6	17	19	18	=	60
	4.	6	18	20	20	=	64
				(6, 14)			
Palpi................		4	7	8	7	=	26

One female from Queensland.

Genus Pediana E. Simon.

Heteropoda L. Koch, Ar. Austr. 1875 (ad partim *H. regina*).
Pediana E. Simon, Rev. Spar. 1880, p. 38.
Polydamna Thor. Rag. Mal. e Pap. 1881, p. 299.
Pediana E. Simon, Hist. Nat. des Ar. vol. ii. p. 56.

Type species, *P. regina* L. Koch.

This genus was formed by M. Simon in 1880 for L. Koch's *Heteropoda regina* from Queensland, and Thorell soon after picked it out for a new genus which he called *Polydamna*, from Yule Island, Torres Strait. Apparently the only male known is described by the latter, and his description of the male palp with four spirals confirms my belief that it belonged to this group and not to the Heteropodeæ, to which it could be ascribed only by the length of the median eye-space.

My *Isopeda horni* (Horn Exp. vol. ii. Zool. p. 340) really belongs to this genus, and two more species in the British Museum now bring up the number to four. The whole eye-space is raised up on a low flat tubercular region. The legs are rather short and thin, the two front pairs being of equal length. The rear row of eyes is slightly procurved, the eyes being about equal in size; the front row straight or recurved, with the eyes either equal or the laterals slightly larger. The median eye-square is clearly longer than broad.

The species can be distinguished as follows:—

a. Front row of eyes equal in size.
  *a*¹. On underside of abdomen a black lunate transverse stripe behind epigyne and similar smaller stripe in front of spinnerets; intermediate space bright reddish brown. Cephalothorax 6 to 7 mm. in length. One spine on tibia iii. and iv. above .. . *regina* L. K.
  *b*¹. An ill-defined dark patch behind epigyne; no stripe in front of spinnerets; intermediate space dull yellow-brown, with irregular dark spots. Cephalothorax about 10 mm. in length. No spine on tibia iii. or iv. above .... *horni* Hogg.
b. Front lateral eyes larger than median. One spine on tibia iii. and iv.
  *c*¹. On the underside of femora i. and ii. bright red hair. Cephalothorax about 10 mm. long. Eyes bright orange .... *tenuis*, nov. sp.
  *d*¹. Underside of femora yellowish brown, dark, hairy. Cephalothorax 6 to 7 mm. long. Eyes black. Three teeth only on outer side of falx-sheath .. . . . *occidentalis*, nov. sp.

Pediana regina (L. Koch).

Heteropoda regina L. Koch, Die Arachn. Austr. vol. ii. 1875, p. 716.

Pediana regina L. Koch, E. Simon, Rev. Sparass. 1880, p. 39.

Polydamna regina L. Koch, T. Thorell, Rag. Mal. e Pap. vol. iii. 1881, p. 300.

A female in the Keyserling Collection, Brit. Mus., has irregular darker brown patches on a yellow-brown ground on the upperside of the abdomen; on the underside a transverse black spot

close to the front margin, a broad lunate band behind the epigyne, and a smaller black band in front of the spinnerets. Three larger and one very small tooth on underside of falx-sheath, two on upperside.

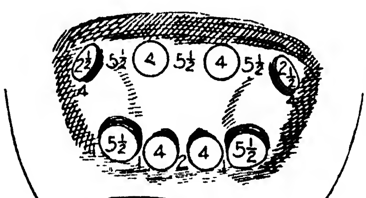
Measurements in millimetres.

	Long.		Broad.
Cephalothorax ...	7		$6\frac{1}{2}$
Abdomen	9		$6\frac{1}{2}$
Mandibles	$3\frac{1}{2}$	=	front patella.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	3	$8\frac{1}{2}$	$9\frac{1}{2}$	$8\frac{1}{2}$	=	$29\frac{1}{2}$
	2.	3	$8\frac{1}{2}$	$9\frac{1}{2}$	$8\frac{1}{2}$	=	$29\frac{1}{2}$
	3.	$2\frac{1}{2}$	7	7	6	=	$22\frac{1}{2}$
	4.	3	8	8	8	=	27
Palpi		$1\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	2	=	$8\frac{1}{2}$

Loc. Yule Island (New Guinea); Cape York, N. Queensland; Bowen, Gayndah, Peak Downs, Queensland.

Text-fig. 102.



A

B

Pediana occidentalis.

A, eyes; B, epigyne.

PEDIANA OCCIDENTALIS, nov. sp. (Text-fig. 102.)

This species is on the whole very like *P. regina*.

The cephalothorax and mandibles are dark red-brown, the hairing pale yellow; lip and maxillæ rather darker; sternum

dark orange; coxæ, legs, and palpi bright orange. Abdomen above rough dark brown skin with fine yellowish hairs; the underside paler with a small dark lunate stripe behind epigyne, but no others.

The *cephalothorax* is rather longer than broad, rounded at sides, a deep thin fovea enlarged at each end, shallow corrugations along each side of thoracic part.

The *eye-space* is on a low flat quadrangle distinctly raised at the rear as well as at the sides; the rear row is clearly procurved, the rearmost point of lateral eyes reaching only to a line passing through the middle of the medians; the eyes equidistant, equal in size to one another and to the front median. These latter are half their diameter apart and about half that distance from the laterals, which are clearly larger than the median.

There are only three teeth on lower edge of falx-sheath, the fourth, small one, of *P. regina* having disappeared. The epigyne of the female is much squarer and more open at the base than in the latter.

Measurements in millimetres.

	Long.	Broad.
Cephalothorax ...	6	$\begin{cases} 3\frac{1}{2} \\ 5 \end{cases}$
Abdomen	8	6
Mandibles	3 longer than pat. i.	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	$2\frac{1}{2}$	$8\frac{1}{2}$	$9\frac{1}{2}$	$8\frac{1}{2}$	=	29
	2.	$2\frac{1}{2}$	$8\frac{1}{2}$	$9\frac{1}{2}$	$8\frac{1}{2}$	=	29
	3.	2	7	7	$6\frac{1}{2}$	=	$22\frac{1}{2}$
	4.	$2\frac{1}{2}$	8	8	8	=	$26\frac{1}{2}$
Palpi		$1\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{1}{2}$	2	=	$8\frac{1}{4}$

Two females from Perth, West Australia, in Brit. Mus.

Pediana horni Hogg.

Isopeda horni Hogg, Rep. Horn Exp. vol. ii. Zool. 1896, p. 340.

The eyes of the front row are equal in size; epigyne oval like that of *P. regina*; no spines on tibia iii. or iv.; the front and rear legs are set on rather straight.

Loc. Oodnadatta, South Australia.

Pediana tenuis, nov. sp. (Text-fig. 103.)

This species more closely resembles the preceding; they are both larger and less brightly coloured than *P. regina*; the eyes are set on a similar raised space.

The cephalothorax, legs, palpi, mandibles, sternum, lip, and maxillæ are all black-brown with pale brown hair. The undersides of the femora of front two pairs of legs are bright red spotted with black; the abdomen above is yellowish grey, below reddish brown hair; a black transverse area behind the epigyne is rather deeper than in *P. horni*, almost a short pointed shield.

The *eyes* are bright orange; those of the front row, on a plane

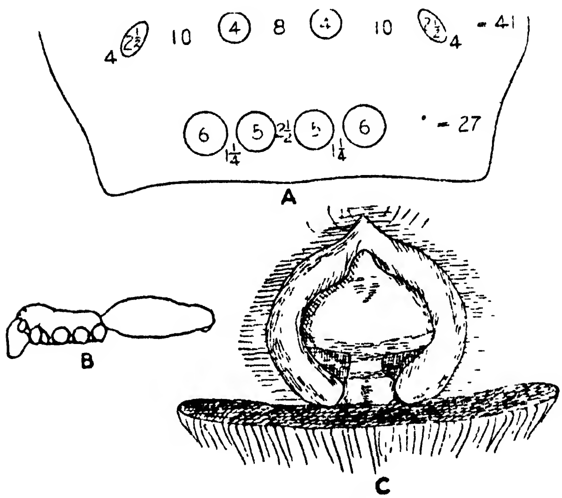
perpendicular to that of the cephalothorax, are straight, the side clearly larger than the median, which are rather nearer to the side than to one another; they are two diameters from the rear median, which are smaller, the four eyes of that row, which is slightly procurved, are equal in size, the median two diameters apart, the laterals two and a half of same distance; clypeus three-quarters diameter of front middle.

The *legs* are short and thin and set on rather straight.

Tibia iii. and iv. have one spine each on upperside.

The *abdomen* is widest near the front, tapering posteriorly. The epigyne is nearly round, the frame-ends at the base not joined, but rather close together.

Text-fig. 103.



Pediana tenuis.

A, eyes; B, profile; C, epigyne.

Measurements in millimetres.

	Long.	Broad.
Cephalothorax ...	10	5 in front. / 9
Abdomen	16	$9\frac{1}{2}$
Mandibles	$4\frac{1}{2}$	= front patella.

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	4	11	13	11	=	39
	2.	4	11	13	11	=	39
	3.	4	9	9	8	=	30
	4.	4	11	11	11	=	37
Palpi		2	4	4	$3\frac{1}{2}$	=	$13\frac{1}{2}$

One female (dried specimen) from West Australia in Brit. Mus.

Genus Eodelena, nov.

This genus I have formed for two specimens, one a fully developed male, the other not adult, sent to the British Museum by Prof. Baldwin Spencer, of Melbourne, in 1888. They were collected on King's Island, Bass's Straits, and, but for their smaller size, in general appearance are scarcely distinguishable from *Delena cancerides* Walck. On looking at the male palp, however, it is seen that what should be a flagellum of ten spirals makes less than one whole turn round the end of the conductor, which is merely flattened and curls round far enough to be the shape of a hook. As the palp does not develop by degrees, but comes out fully formed after casting the skin at the last moult, this must either be a reversion to an ancient form or a remanet. The fact that the palpal development is so similar through different genera indicates that it is an older development than that of the form of cephalothorax &c.; and as the flattened forms must almost of a certainty succeed the unflattened, it is more likely to be a reversion to the original type than to have remained on without alteration. However, if such were thought likely, the hills (now islands in Bass's Straits) would be a not unlikely place for the ancestors to remain. It is in any case an interesting instance of the reproduction of a missing link, and indicates the line along which the specialization has taken place.

Type, *Eodelena spenceri*.

Eodelena spenceri, nov. sp. (Text-fig. 104.)

This species differs in nowise in coloration and shape from *Delena cancerides*, but has the important difference detailed above, and the tibial apophysis of male palp is single instead of double.

In the front row of eyes the laterals are nearer to the medians than in that species, being once and a half the distance between the latter.

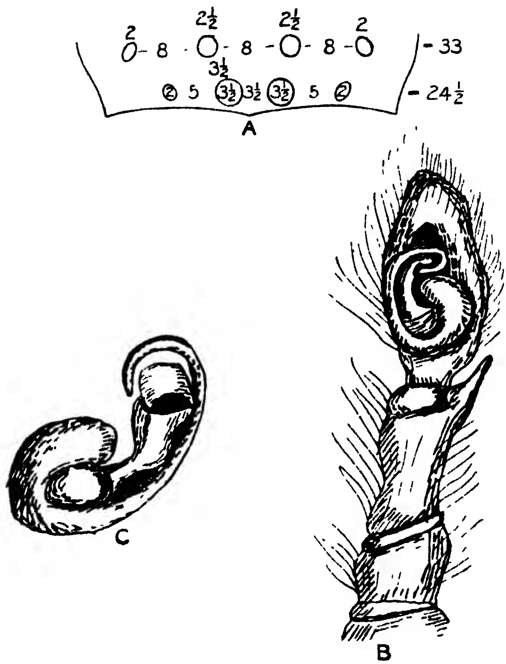
Measurements in millimetres.

Male.

	Long.	Broad.
Cephalothorax ...	$6\frac{1}{2}$	$6\frac{1}{2}$
Abdomen	$6\frac{1}{2}$	$5\frac{1}{2}$
Mandibles	3	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	$2\frac{1}{2}$	8	$10\frac{1}{2}$	$9\frac{1}{2}$	=	$30\frac{1}{2}$
	2.	$2\frac{1}{2}$	10	13	12	=	$37\frac{1}{2}$
	3.	2	7	7	7	=	23
	4.	$2\frac{1}{4}$	8	8	8	=	$26\frac{1}{4}$
Palpi		1	$2\frac{1}{2}$	$1\frac{1}{2}$	2	=	7

Text-fig. 104.



Eodelena spenceri.

A, eyes; B, male palp; C, flagellum and support.

Female (not fully adult).

	Long.	Broad.
Cephalothorax ...	6½	6½
Abdomen	9	7
Mandibles	3	

		Coxæ.	Tr. & fem.	Pat. & tib.	Metat. & tars.		
Legs	1.	2½	8½	9	8½	=	28½
	2.	2½	8	8½	8	=	27
	3.	2¼	7	7	7	=	23¼
	4.	2½	8½	8½	8½	=	28
Palpi							

Genus Delena Walck.

Delena Walck. Apt. tom. i. p. 490 (1837).

Delena cancerides Walck.

This is the only species of the genus found on the mainland of

Australia and has been recorded from wherever collections have been made at all.

Walckenaer states that the first specimens were brought to Europe from Tasmania by M. Péron (in 1804). The cephalothorax and abdomen are more flattened than in any other species of the family, while the typically laterigrade position of its legs enables it to hide in very narrow crevices, but otherwise leaves it rather helpless. It is somewhat remarkable that with its wide range there should be very little variation in colour or form, this being the only species in the Australasian region. The palpal spiral has ten or eleven turns.

Loc. Australia, Tasmania.

I wish heartily to express my great indebtedness to Prof. Stirling, F.R.S., of the South Australian Museum, Adelaide, for providing me with much important material, and to Mr. R. I. Pocock, of the British Museum, not only for placing at my disposal the collection in his charge, but for his valuable advice, freely given on the many occasions when doubts and difficulties have presented themselves.

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THE END.

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